SiRF Binary Protocol Reference Manual

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SiRF Binary Protocol Reference Manual

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Preface

The *SiRF Binary Protocol Reference Manual* provides detailed information about the SiRF Binary protocol - the standard protocol used by all SiRF architectures.

Who Should Use This Guide

This manual was written assuming the user is familiar with interface protocols, including their definitions and use.

How This Guide Is Organized

Chapter 1, "Protocol Layers" information about SiRF Binary protocol layers.

Chapter 2, "Input Messages" definitions and examples of each available SiRF Binary input messages.

Chapter 3, "Output Messages" definitions and examples of each available SiRF Binary output messages.

Chapter 4, "Additional Information" Other useful information pertaining to the SiRF Binary protocol.

Related Manuals

You can also refer to the following literature for additional information:

- *SiRF NMEA Reference Manual*
- *ICD-GPS-200*
- *RTCM Recommended Standards for Differential GNSS*

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Helpful Information When Contacting SiRF Technical Support

Receiver Serial Number: _____

Receiver Software Version: _____

SiRFdemo Version: _____

Protocol Layers 1

The SiRF Binary protocol is the standard interface protocol used by all SiRF-based products.

This serial communication protocol is designed to include:

- Reliable transport of messages
- Ease of implementation
- Efficient implementation
- Independence from payload.

Transport Message

Start Sequence	Payload Length	Payload	Message Checksum	End Sequence
0xA0[1], 0xA2	Two-bytes (15-bits)	Up to 2^{10} -1 (<1023)	Two-bytes (15-bits)	0xB0, 0xB3

1. Characters preceded by “0x” denotes a hexadecimal value. 0xA0 equals 160.

Transport

The transport layer of the protocol encapsulates a GPS message in two start characters and two stop characters. The values are chosen to be easily identifiable and unlikely to occur frequently in the data. In addition, the transport layer prefixes the message with a 2-byte (15-bit) message length and adds a 2-byte (15-bit) checksum before the two stop characters. The values of the start and stop characters and the choice of a 15-bit value for length and checksum ensure message length and checksum can not alias with either the stop or start code.

Message Validation

The validation layer is of part of the transport, but operates independently. The byte count refers to the payload byte length. The checksum is a sum on the payload.

Payload Length

The payload length is transmitted high order byte first followed by the low byte.

High Byte	Low Byte
< 0x7F	Any value

Even though the protocol has a maximum length of (2^{15}-1) bytes, practical considerations require the SiRF GPS module implementation to limit this value to a smaller number. The SiRF receiving programs (e.g., SiRFdemo) may limit the actual size to something less than this maximum.

Payload Data

The payload data follows the payload length. It contains the number of bytes specified by the payload length. The payload data may contain any 8-bit value.

Where multi-byte values are in the payload data neither the alignment nor the byte order are defined as part of the transport although SiRF payloads will use the big-endian order.

Checksum

The checksum is transmitted high order byte first followed by the low byte. This is the so-called big-endian order.

High Byte	Low Byte
< 0x7F	Any value

The checksum is 15-bit checksum of the bytes in the payload data. The following pseudo code defines the algorithm used.

Let message to be the array of bytes to be sent by the transport.

Let msgLen be the number of bytes in the message array to be transmitted.

Index = first

checkSum = 0

while index < msgLen

checkSum = checkSum + message[index]

checkSum = checkSum AND (2^{15}-1).

Input Messages 2

The following chapter provides full information about available SiRF Binary input messages. For each message, a full definition and example is provided.

Note – The limit for the buffer size is 912 bytes for input messages.

Table 2-1 lists the message list for the SiRF Binary input messages.

Table 2-1 SiRF Messages - Input Message List

Hex	Decimal	Name	Description
35	53	Advanced Power Management	Power management scheme for SiRFLoc and SiRFXTrac
80	128	Initialize Data Source	Receiver initialization and associated parameters
81	129	Switch to NMEA Protocol	Enable NMEA messages, output rate and baud rate
82	130	Set Almanac (upload)	Sends an existing almanac file to the receiver
83	131	Handle Formatted Dump Data	Outputs formatted data
84	132	Poll Software Version	Polls for the loaded software version
85	133	DGPS Source Control	DGPS correction source and beacon receiver information
86	134	Set Binary Serial Port	Baud rate, data bits, stop bits, and parity
88	136	Mode Control	Navigation mode configuration
89	137	DOP Mask Control	DOP mask selection and parameters
8A	138	DGPS Mode	DGPS mode selection and timeout value
8B	139	Elevation Mask	Elevation tracking and navigation masks
8C	140	Power Mask	Power tracking and navigation masks
8F	143	Static Navigation	Configuration for static operation
90	144	Poll Clock Status	Polls the clock status
91	145	Set DGPS Serial Port	DGPS port baud rate, data bits, stop bits, and parity
92	146	Poll Almanac	Polls for almanac data
93	147	Poll Ephemeris	Polls for ephemeris data
94	148	Flash Update	On the fly software update
95	149	Set Ephemeris (upload)	Sends an existing ephemeris to the receiver
96	150	Switch Operating Mode	Test mode selection, SV ID, and period.
97	151	Set TricklePower Parameters	Push to fix mode, duty cycle, and on time
98	152	Poll Navigation Parameters	Polls for the current navigation parameters

Table 2-1 SiRF Messages - Input Message List *(Continued)*

Hex	Decimal	Name	Description
A5	165	Set UART Configuration	Protocol selection, baud rate, data bits, stop bits, and parity
A6	166	Set Message Rate	SiRF Binary message output rate
A7	167	Set Low Power Acquisition Parameters	Low power configuration parameters
A8	168	Poll Command Parameters	Poll for parameters: 0x80: Receiver initialized & associated params 0x85: DGPS source and beacon receiver info 0x88: Navigation mode configuration 0x89: DOP mask selection and parameters 0x8A: DGPS mode selection and timeout values 0x8B: Elevation tracking and navigation masks 0x8C: Power tracking and navigation masks 0x8F: Static navigation configuration 0x97: Low power parameters
AA	170	Set SBAS Parameters	SBAS configuration parameters
AC	172	SiRFDRive-specific Class of Input Messages	The MID is partitioned into messages identified by Sub IDs. Refer to Table 2-2.
B4-C7	180-199	MID_UserInputBegin - MID_UserInputEnd	SDK user input messages only.
B4	180	Marketing Software Configuration	Selection of the Marketing Software Configurations as defined in bits [3:2] of the GSC2xr chip configuration register
B6	182	Set UART Configuration	Obsolete.
E4	228	SiRF internal message	Reserved
E8	232	Extended Ephemeris Proprietary	Extended Ephemeris and Debug Flag

Table 2-2 Sub IDs for SiRFDRive Input MID 172 (0xAC)

Sub ID	Message
1	Initialize GPS/DR Navigation
2	Set GPS/DR Navigation Mode
3	Set DR Gyro Factory Calibration
4	Set DR Sensors' Parameters
5	Poll DR Validity (not implemented)
6	Poll DR Gyro Factory Calibration
7	Poll DR Sensors' Parameters

Since the SiRF Binary protocol is evolving standard along with continued development of SiRF software and GPS solutions, not all SiRF Binary messages are supported by all SiRF GPS solutions.

Table 2-3 identifies the supported input messages for each SiRF architecture.

Table 2-3 Supported Input Messages

Message ID	SiRF Software Options				
	GSW2	SiRFDRive	SiRFXTrac	SiRFLoc	GSW3 GSWLT3
53	No	No	Yes	No	No
128	Yes	Yes	Yes	Yes	Yes
129	Yes	Yes	Yes	No	Yes
130	Yes	Yes	No	No	Yes
131	No	No	No	No	Yes
132	Yes	Yes	Yes	Yes	No
133	Yes	Yes	No	No	No
134	Yes	Yes	Yes	Yes	Yes
135	No	No	No	No	Yes
136	Yes	Yes	Yes	Yes	Yes
137	Yes	Yes	Yes	Yes	Yes
138	Yes	Yes	Yes	Yes	No
139	Yes	Yes	Yes	Yes	Yes
140	Yes	Yes	Yes	Yes	Yes
143	Yes	Yes	Yes	Yes	Yes
144	Yes	Yes	Yes	Yes	Yes
145	Yes	Yes	No	No	No
146	Yes	Yes	No	Yes	Yes
147	Yes	Yes	No	Yes	Yes
148	Yes	Yes	Yes	No	No
149	Yes	Yes	No	Yes	Yes
150	Yes	Yes	Yes	Yes	Yes
151	Yes	Yes	Yes	No	Yes
152	Yes	Yes	Yes	Yes	Yes
165	Yes	Yes	Yes	No	Yes
166	Yes	Yes	Yes	Yes	Yes
167	Yes	Yes	Yes	No	Yes
168	Yes	Yes	Yes	Yes	Yes
170	2.3 or above	Yes	No	No	Yes
172	No	Yes	No	No	Yes
175	No	No	No	No	Yes
180[1]	Yes	No	No	No	No
180-199	Yes	Yes	Yes	Yes	Yes
182	No	No	No	No	No
228	No	No	No	No	Yes (reserved)
232	2.5 or above	No	2.3 or above	No	3.2.0 or above

1. Only with GSC2xr chip.

Advanced Power Management - Message ID 53

Used to implement Advanced Power Management (APM). APM allows power savings while ensuring that the quality of the solution is maintained when signal levels drop. APM will not engage until all information is received.

Example:

The following example sets the receiver to operate in APM mode with 0 cycles before sleep (continuous operation), 20 seconds between fixes, 50% duty cycle, a time between fixes priority, and no preference for accuracy.

A0A2000C—Start Sequence and Payload Length

350100140003070000A0100—Payload

005FB0B3—Message Checksum and End Sequence

Table 2-4 Advanced Power Management - Message ID 53

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		35		Decimal 53
APM Enabled	1		01		1=True, 0=False
Number Fixes	1		00		Number of requested APM cycles. Range 0-255[1]
Time Between Fixes	1	1	14	Sec	Requested time between fixes. Range 0-255[2]
Spare Byte 1	1		00		Reserved
Maximum Horizontal Error	1		03		Maximum requested horizontal error (See Table 2-5).
Maximum Vertical Error	1		07		Maximum requested vertical error (See Table 2-5).
Maximum Response Time	1	1	00	Sec	Maximum response time. Not currently used.
Time Acc Priority	1		00		0x00=No priority, 0x01=Response Time Max has higher priority, 0x02=Horizontal Error Max has higher priority. Not currently used.
Power Duty Cycle	1	5	0A	%	Power Duty Cycle, defined as the time in full power to total operation time. 1->20; duty cycle (%) is this value *5.[3]
Time Duty Cycle	1		01		Time/Power Duty cycle priority. 0x01 = Time between two consecutive fixes has priority 0x02 = Power Duty cycle has higher priority. Bits 2..7 reserved for expansion.
Spare Byte 2	1		00		Reserved.

Payload length: 12 bytes

1. A value of zero indicates that continuous APM cycles is requested.
2. It is bound from 10 to180 s.
3. If a duty-cycle of 0 is entered, it will be rejected as out of range. If a duty cycle value of 20 is entered, the APM module is disabled and continuous power operation is resumed.

Table 2-5 Horizontal/Vertical Error

Value	Position Error
0x00	< 1 meter
0x01	< 5 meter
0x02	< 10 meter
0x03	< 20 meter
0x04	< 40 meter
0x05	< 80 meter
0x06	< 160 meter
0x07	No Maximum
0x08 - 0xFF	Reserved

Initialize Data Source - Message ID 128

This message causes the receiver to restart. Optionally, it can provide position, clock drift and time data to initialize the receiver.

Note – Some software versions will not support use of the initializing data.

Table 2-6 contains the input values for the following example:

Command a Warm Start with the following initialization data: ECEF XYZ (-2686727 m, -4304282 m, 3851642 m), Clock Offset (75,000 Hz), Time of Week (86,400 sec), Week Number (924), and Channels (12). Raw track data enabled, Debug data enabled.

Example:

A0A20019—Start Sequence and Payload Length

80FFD700F9FFBE5266003AC57A000124F80083D600039C0C33—Payload

0A91B0B3—Message Checksum and End Sequence

Table 2-6 Initialize Data Source - Message ID 128

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		80		Decimal 128
ECEF X	4		FFD700F9	meters	
ECEF Y	4		FFBE5266	meters	
ECEF Z	4		003AC57A	meters	
Clock Drift	4		000124F8	Hz	
Time of Week	4	*100	0083D600	seconds	
Week Number	2		51F		Extended week number (0 - no limit)
Channels	1		0C		Range 1-12
Reset Configuration Bit Map.	1		33		See Table 2-7

Payload length: 25 bytes

Table 2-7 Reset Configuration Bit Map

Bit	Description
0	Data valid flag -- 1=Use data in ECEF X, Y, Z, Clock Offset, Time of Week and Week number to initialize the receiver; 0=Ignore data fields.
1	Clear ephemeris from memory -- blocks Snap or Hot Start from occurring.
2	Clear all history (except clock drift) from memory -- blocks Snap, Hot, and Warm Starts.
3	Factory Reset -- clears all GPS memory including clock drift. Also clears almanac stored in flash memory.
4	Enable Nav Lib data (YES=1, NO=0).[1]
5	Enable debug data (YES=1, NO=0).
6	Indicate that Real-Time Clock (RTC) is not precise -- blocks Snap Start.
7	Clear user data in memory.

1. If Nav Lib data are enabled, the resulting messages are enabled: Clock Status (MID 7), 50BPS (MID 8), Raw DGPS (MID 17), NL Measurement Data (MID 28), DGPS Data (MID 29), SV State Data (MID 30), and NL Initialized Data (MID 31). All messages are sent at 1 Hz. If SiRFDemo is used to enable Nav Lib data, the Baud rate is automatically set to 57600 by SiRFDemo.

Switch To NMEA Protocol - Message ID 129

This message switches a serial port from binary to NMEA protocol and sets message output rates and baud rate on the port.

Table 2-8 contains the input values for the following example:

Request the following NMEA data at 9600 baud:
GGA – ON at 1 sec, GLL – OFF, GSA - ON at 1sec,
GSV – ON at 5 sec, RMC – ON at 1sec, VTG-OFF, MSS – OFF, ZDA-OFF.

Example:

A0A20018—Start Sequence and Payload Length

810201010001010105010101000100010001000100012580—Payload

013AB0B3—Message Checksum and End Sequence

Table 2-8 Switch To NMEA Protocol - Message ID 129

Name	Bytes	Example	Units	Description
Message ID	1	0x81		Decimal 129
Mode	1	0x02		See Table 2-9
GGA Message[1]	1	0x01	sec	See NMEA Protocol Reference Manual for format.
Checksum[2]	1	0x01		Send checksum with GGA message
GLL Message	1	0x00	sec	See NMEA Protocol Reference Manual for format.
Checksum	1	0x01		
GSA Message	1	0x01	sec	See NMEA Protocol Reference Manual for format.
Checksum	1	0x01		
GSV Message	1	0x05	sec	See NMEA Protocol Reference Manual for format.
Checksum	1	0x01		
RMC Message	1	0x01	sec	See NMEA Protocol Reference Manual for format.
Checksum	1	0x01		
VTG Message	1	0x00	sec	See NMEA Protocol Reference Manual for format.
Checksum	1	0x01		

Table 2-8 Switch To NMEA Protocol - Message ID 129 *(Continued)*

Name	Bytes	Example	Units	Description
MSS Message	1	0x00	sec	Output rate for MSS message
Checksum	1	0x01		
Unused Field[3]	1	0x00		
Unused Field[3]	1	0x00		
ZDA Message	1	0x00	sec	See NMEA Protocol Reference Manual for format.
Checksum	1	0x01		
Unused Field[3]	1	0x00		
Unused Field[3]	1	0x00		
Baud Rate	2	0x2580		1200, 2400, 4800, 9600, 19200, 38400, and 57600

Payload length: 24 bytes

1. A value of 0x00 implies not to send message, otherwise data is sent at 1 message every X seconds requested (e.g., to request a message to be sent every 5 seconds, request the message using a value of 0x05). Maximum rate is 1/255 sec.
2. A value of 0x00 implies the checksum is not transmitted with the message (not recommended). A value of 0x01 will have a checksum calculated and transmitted as part of the message (recommended).
3. These fields are available if additional messages have been implemented in the NMEA protocol.

Table 2-9 Mode Values

Value	Meaning
0	Enable NMEA debug messages
1	Disable NMEA debug messages
2	Do not change last-set value for NMEA debug messages

In TricklePower mode, update rate is specified by the user. When switching to NMEA protocol, the message update rate is also required. The resulting update rate is the product of the TricklePower update rate and the NMEA update rate (e.g., TricklePower update rate = 2 seconds, NMEA update rate = 5 seconds, resulting update rate is every 10 seconds, (2 X 5 = 10)).

Note – To return to the SiRF Binary protocol, send a SiRF NMEA message to revert to SiRF binary mode. (See the *SiRF NMEA Reference Manual* for more information).

Set Almanac - Message ID 130

This command enables the user to upload an almanac file to the receiver.

Note – Some software versions do not support this command.

Example:

A0A20381 – Start Sequence and Payload Length

82xx……. – Payload

xxxxB0B3 – Message Checksum and End Sequence

Table 2-10 Set Almanac - Message ID 130

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		82		Decimal 130
Almanac	896		00		Reserved

Payload length: 897 bytes

The almanac data is stored in the code as a 448-element array of **INT16** values. These elements are partitioned as a 32 x 14 two-dimensional array where the row represents the satellite ID minus 1 and the column represents the number of **INT16** values associated with this satellite. The data is actually packed and the exact format of this representation and packing method can be extracted from the *ICD-GPS-200* document. The *ICD-GPS-200* document describes the data format of each GPS navigation sub-frame and is available on the web at http://www.arinc.com/gps.

Handle Formatted Dump Data - Message ID 131

This command requests the output of formatted data from anywhere within the receiver's memory map. It is designed to support software development and can handle complex data types up to an array of structures. Message ID 10 Error 255 will be sent in response to this message.

Note – The limit for the buffer size is 912 bytes.

Table 2-11 contains the input values for the following example. This example shows how to output an array of elements. Each element structure appears as follows:

```
Typedef structure // structure size = 9 bytes
{
    UINT8 Element 1
    UINT16 Element 2
    UINT8 Element 3
    UINT8 Element 4
    UINT32 Element 5
} tmy_struct
tmy_struc my_struct [3]
```

Example:

A0A2002B—Start Sequence and Payload Length

830360001050050102010104486 56C6C6F00253264202532642025326420253264202531302E316C660000—Payload

0867B0B3—Message Checksum and End Sequence

Table 2-11 Handle Formatted Dump Data -Message Parameters

Name	Bytes	Binary (Hex) Example	Units	Description
Message ID	1	83		Decimal 131.
Elements	1	03		Number of elements in array to dump (minimum 1).
Data address	4	60000150		Address of the data to be dumped.
Members	1	05		Number of items in the structure to be dumped.
Member Size	Elements	01 02 01 01 04	Bytes	List of element sizes in the structure. See Table 2-12 for definition of member size (total of 5 for this example).
Header	string length + 1	“Hello”0		String to print out before data dump (total of 8 bytes in this example).
Format	string length + 1	“%2d %2d %2d %2d %10.1lf”0		Format string for one line of output (total of 26 bytes in this example) with 0 termination.
Trailer	string length + 1	00		Not used.

Payload length: Variable

Table 2-12 defines the values associated with the member size data type.

Table 2-12 Member Size Data Type

Data Type	Value for Member Size (Bytes)
char, INT8, UINT8	1
short int, INT16, UINT16, SINT16, BOOL16	2
long int, float, INT32, UINT32, SINT32, BOOL32, FLOAT32	4
long long, double INT64, DOUBLE64	8

Poll Software Version - Message ID 132

This message requests the output of the software version string. Message ID 6 will be sent in response.

Table 2-13 contains the input values for the following example:

Poll the software version

Example:

A0A20002—Start Sequence and Payload Length

8400—Payload

0084B0B3—Message Checksum and End Sequence

Table 2-13 Software Version - Message ID 132

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		84		Decimal 132
Control	1		00		Not used

Payload length: 2 bytes

DGPS Source - Message ID 133

This command allows the user to select the source for Differential GSP (DGPS) corrections. The default source is external RTCM data on the secondary serial port. Options available are:

External RTCM Data (any serial port)

Satellite Based Augmentation System (SBAS) - subject to SBAS satellite availability

Internal DGPS beacon receiver

Example 1: Set the DGPS source to External RTCM Data

A0A200007—Start Sequence and Payload Length

85020000000000—Payload

0087B0B3—Checksum and End Sequence

Table 2-14 DGPS Source Selection (Example 1)

Name	Bytes	Scale	Hex	Units	Decimal	Description
Message ID	1		85		133	Message Identification
DGPS Source	1		02		2	See Table 2-16.
Internal Beacon Frequency	4		00000000		0	Not used
Internal Beacon Bit Rate	1		0		0	Not used

Payload length: 7 bytes

Example 2: Set the DGPS source to Internal DGPS Beacon Receiver

Search Frequency 310000, Bit Rate 200

A0A200007—Start Sequence and Payload Length

85030004BAF0C802—Payload

02FEB0B3—Checksum and End Sequence

Table 2-15 DGPS Source Selection (Example 2)

Name	Bytes	Scale	Hex	Units	Decimal	Description
Message ID	1		85		133	Message Identification.
DGPS Source	1		03		3	See Table 2-16.
Internal Beacon Frequency	4		0004BAF0	Hz	310000	See Note 1.
Internal Beacon Bit Rate	1		C8	BPS	200	See Note 2.

Payload length: 7 bytes

Note – 1 - Beacon frequency valid range is 283500 to 325000 Hz. A value of zero indicates the Beacon should be set to automatically scan all valid frequencies.

Note – 2 - Bit rates may be 25, 50, 100 or 200 BPS. A value of zero indicates the Beacon should be set to automatically scan all bit rates.

Table 2-16 DGPS Source Selections

Value	DGPS Source	Description
0	None	DGPS corrections are not used (even if available).
1	SBAS	Uses SBAS Satellite (subject to availability).
2	External RTCM Data	External RTCM input source (e.g., Coast Guard Beacon).
3	Internal DGPS Beacon Receiver	Internal DGPS beacon receiver.
4	User Software	Corrections provided using a module interface routine in a custom user application.

Set Binary Serial Port - Message ID 134

This message sets the serial port values that are used whenever the binary protocol is activated on a port. It also sets the current values for the port currently using the binary protocol.

Table 2-17 contains the input values for the following example:

Set Binary serial port to 9600,n,8,1.

Example:

A0A20009—Start Sequence and Payload Length

860000258008010000—Payload

0134B0B3—Message Checksum and End Sequence

Table 2-17 Set Main Serial Port - Message ID 134

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		86		Decimal 134
Baud	4		00002580		1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200
Data Bits	1		08		8
Stop Bit	1		01		1=1 Stop Bit
Parity	1		00		None=0, Odd=1, Even=2
Pad	1		00		Reserved

Payload length: 9 bytes

Mode Control - Message ID 136

This message sets up the navigation operations. It controls use of fewer than four satellites, and enables or disables the track smoothing filter.

Table 2-18 contains the input values for the following example:

TBD=0, Alt Constraining = Yes, Degraded Mode = clock then direction, TBD=0, TBD=0, Altitude = 0, Alt Hold Mode = Auto, Alt Source =Last Computed, TBD=0, Degraded Time Out=5, DR Time Out = 2, Track Smoothing = Yes

Example:

A0A2000E—Start Sequence and Payload Length

880000010000000000000050201—Payload

0091B0B3—Message Checksum and End Sequence

Table 2-18 Mode Control - Message ID 136

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		88		Decimal 136
TBD	2		0000		Reserved
Degraded Mode	1		01		Controls use of 2-SV and 1-SV solutions. See Table 2-19
TBD	2		0000		Reserved
Altitude	2		0000	meters	User specified altitude, range -1,000 to +10,000
Alt Hold Mode	1		00		Controls use of 3-SV solution.See Table 2-20
Alt Hold Source	1		00		0=Use last computed altitude, 1=Use user-input altitude
TBD	1		00		Reserved
Degraded Time Out	1		05	seconds	0=disable degraded mode, 1-120 seconds degraded mode time limit

Table 2-18 Mode Control - Message ID 136 *(Continued)*

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
DR Time Out	1		02	seconds	0=disable dead reckoning, 1-120 seconds dead reckoning mode time limit
Track Smoothing	1		01		0=disable, 1=enable

Payload length: 14 bytes

Table 2-19 Degraded Mode

Byte Value	Description
0	Allow 1-SV navigation, freeze direction for 2-SV fix, then freeze clock drift for 1-SV fix.
1	Allow 1-SV navigation, freeze clock drift for 2-SV fix, then freeze direction for 1-SV fix.
2	Allow 2-SV navigation, freeze direction. Does not allow 1-SV solution.
3	Allow 2-SV navigation, freeze clock drift. Does not allow 1-SV solution.
4	Do not allow Degraded Modes (2-SV and 1-SV navigation).

Table 2-20 Altitude Hold Mode

Byte Value	Description
0	Automatically determine best available altitude to use
1	Always use user-input altitude
2	Do not use altitude hold

DOP Mask Control - Message ID 137

Dilution of Precision (DOP) is a measure of how the geometry of the satellites affects the current solution's accuracy. This message provides a method to restrict use of solutions when the DOP is too high. When the DOP mask is enabled, solutions with a DOP higher than the set limit will be marked invalid. Table 2-21 contains the input values for the following example:

Auto PDOP/HDOP, GDOP=8 (default), PDOP=8,HDOP=8

Example:

A0A20005—Start Sequence and Payload Length

8900080808—Payload

00A1B0B3—Message Checksum and End Sequence

Table 2-21 DOP Mask Control - Message ID 137

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		89		Decimal 137
DOP Selection	1		00		See Table 2-22
GDOP Value	1		08		Range 1 to 50

Table 2-21 DOP Mask Control - Message ID 137 *(Continued)*

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
PDOP Value	1		08		Range 1 to 50
HDOP Value	1		08		Range 1 to 50

Payload length: 5 bytes

Table 2-22 DOP Selection

Byte Value	Description
0	Auto: PDOP for 3-D fix; HDOP for 2-D fix
1	PDOP
2	HDOP
3	GDOP
4	Do Not Use

DGPS Control - Message ID 138

This message enables users to control how the receiver uses differential GPS (DGPS) corrections.

Table 2-23 contains the input values for the following example:

Set DGPS to exclusive with a time out of 30 seconds.

Example:

A0A20003—Start Sequence and Payload Length

8A011E—Payload

00A9B0B3—Message Checksum and End Sequence

Table 2-23 DGPS Control - Message ID 138

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		8A		Decimal 138
DGPS Selection	1		01		See Table 2-24
DGPS Time Out:	1		1E	seconds	Range 0 to 255

Payload length: 3 bytes

Table 2-24 DGPS Selection

Byte Value	Description
0	Auto = use corrections when available
1	Exclusive = include into navigation solution only SVs with corrections
2	Never Use = ignore corrections

Note – DGPS Timeout interpretation varies with DGPS correction source. For internal beacon receiver or RTCM SC-104 external source, a value of 0 means infinite timeout (use corrections until another one is available). A value of 1-255 means use the corrections for a maximum of this many seconds. For DGPS corrections from an SBAS source, the timeout value is ignored unless Message ID 170, Flag bit 0 is set to 1 (User Timeout). If MID 170 specifies User Timeout, a value of 1 to 255 here means that SBAS corrections may be used for the number of seconds specified. A value of 0 means to use the timeout specified in the SBAS satellite message (usually 18 seconds).

Elevation Mask - Message ID 139

Elevation mask is an angle above the horizon. Unless a satellite's elevation is greater than the mask, it will not be used in navigation solutions. This permits the receiver to avoid using the satellites most likely to have multipath problems.

Table 2-25 contains the input values for the following example:

Set Navigation Mask to 15.5 degrees (Tracking Mask is defaulted to 5 degrees).

Example:

A0A20005—Start Sequence and Payload Length

8B0032009B—Payload

0158B0B3—Message Checksum and End Sequence

Table 2-25 Elevation Mask - Message ID 139

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		8B		Decimal 139
Tracking Mask	2	*10	0032	degrees	Not implemented
Navigation Mask	2	*10	009B	degrees	Range -20.0 to 90.0

Payload length: 5 bytes

Note – Satellite with elevation angle relative to the local horizon that is below the specified navigation mask angle will not be used in the navigation solution.

Power Mask - Message ID 140

The power mask is a limit on which satellites are used in navigation solutions. Satellites with signals lower than the mask are not used.

Table 2-26 contains the input values for the following example:

Navigation mask to 33 dB-Hz (tracking default value of 28)

Example:

A0A20003—Start Sequence and Payload Length

8C1C21—Payload

00C9B0B3—Message Checksum and End Sequence

Table 2-26 Power Mask - Message ID 140

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		8C		Decimal 140
Tracking Mask	1		1C	dBHz	Not implemented
Navigation Mask	1		21	dBHz	Range 20[1] to 50

Payload length: 3 bytes

1. The range for GSW3 and GSWLT3 is 12 to 50.

Note – Satellites with received signal strength below the specified navigation mask signal level will not used in the navigation solution.

Static Navigation - Message ID 143

This command allows the user to enable or disable static navigation to the receiver.

Example:

A0A20002 – Start Sequence and Payload Length

8F01 – Payload

0090B0B3 – Message Checksum and End Sequence

Table 2-27 Static Navigation - Message ID 143

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		8F		Decimal 143
Static Navigation Flag	1		01		1 = enable; 0 = disable

Payload length: 2 bytes

Note – Static navigation is a position filter designed to be used with motor vehicles. When the vehicle's velocity falls below a threshold, the position and heading are frozen, and velocity is set to zero. This condition will continue until the computed velocity rises above 1.2 times the threshold or until the computed position is at least a set distance from the frozen place. The threshold velocity and set distance may vary with software versions.

Poll Clock Status - Message ID 144

This message causes the receiver to report the most recently computed clock status. The resulting clock status is reported in message ID 7.

Table 2-28 contains the input values for the following example:

Poll the clock status.

Example:

A0A20002—Start Sequence and Payload Length

9000—Payload

0090B0B3—Message Checksum and End Sequence

Table 2-28 Clock Status - Message ID 144

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		90		Decimal 144
Control	1		00		Not used

Payload length: 2 bytes

Note – Returned message will be MID 7. See “Response: Clock Status Data - Message ID 7” on page 3-8.

Set DGPS Serial Port - Message ID 145

This message sets the serial port settings associated with the RTCM protocol. If the RTCM protocol is currently assigned to a port, it will also change that port’s settings. The values entered are stored in battery-backed RAM and are used whenever the RTCM protocol is assigned to a port.

Table 2-29 contains the input values for the following example:

Set DGPS Serial port to 9600,n,8,1.

Example:

A0A20009—Start Sequence and Payload Length

910000258008010000—Payload

013FB0B3—Message Checksum and End Sequence

Table 2-29 Set DGPS Serial Port - Message ID 145

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		91		Decimal 145
Baud	4		00002580		1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200
Data Bits	1		08		8,7
Stop Bit	1		01		0,1
Parity	1		00		None=0, Odd=1, Even=2
Pad	1		00		Reserved

Payload length: 9 bytes

Note – Setting the DGPS serial port using MID 145 will affect Com B only regardless of the port being used to communicate with the Evaluation Receiver.

Poll Almanac - Message ID 146

This message causes the most recently stored almanacs to be reported by the receiver. Almanacs are reported in message ID 14, with a total of 32 messages being sent in response.

Note – Some software versions do not support this command.

Table 2-30 contains the input values for the following example:

Poll for the almanac.

Example:

A0A20002—Start Sequence and Payload Length

9200—Payload

0092B0B3—Message Checksum and End Sequence

Table 2-30 Almanac - Message ID 146

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		92		Decimal 146
Control	1		00		Not used

Payload length: 2 bytes

Note – Returned message is MID 14. See “Almanac Data - Message ID 14” on page 3-22.

Poll Ephemeris - Message ID 147

This message causes the receiver to respond with the ephemeris of the requested satellite. The ephemeris is sent using message ID 15. It can also request all ephemerides, resulting in as many Message 15s as there are ephemerides currently stored in the receiver.

Note – Some software versions do not support this command.

Table 2-31 contains the input values for the following example:

Poll for Ephemeris Data for all satellites.

Example:

A0A20003—Start Sequence and Payload Length

930000—Payload

0092B0B3—Message Checksum and End Sequence

Table 2-31 Ephemeris - Message ID 147

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		93		Decimal 147
Sv ID[1]	1		00		Range 0 to 32
Control	1		00		Not used

Payload length: 3 bytes

1. A value of zero requests all available ephemeris records. This will result in a maximum of twelve output messages. A value of 1 through 32 will request only the ephemeris of that SV.

Note – Returned message will be MID 15. See “Ephemeris Data (Response to Poll) – Message ID 15” on page 3-23.

Flash Update - Message ID 148

This command allows the user to command the receiver to go into internal boot mode without setting the boot switch. Internal boot mode allows the user to re-flash the embedded code in the receiver.

Note – It is highly recommended that all hardware designs should still provide access to the boot pin in the event of a failed flash upload.

Example:

A0A20001 – Start Sequence and Payload Length

94 – Payload

0094B0B3 – Message Checksum and End Sequence

Table 2-32 Flash Update - Message ID 148

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		94		Decimal 148

Payload length: 1 bytes

Set Ephemeris - Message ID 149

This command enables the user to upload an ephemeris file to the receiver.

Example:

A0A2005B – Start Sequence and Payload Length

95……. – Payload

xxxxB0B3 – Message Checksum and End Sequence

Table 2-33 Ephemeris - Message ID 149

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		95		Decimal 149
Ephemeris Data	90		00		Reserved

Payload length: 91 bytes

The ephemeris data for each satellite is stored as a two dimensional array of [3][15] UNIT16 elements. The row represents three separate sub-frames. See MID 15 (“Ephemeris Data (Response to Poll) – Message ID 15” on page 3-23) for a detailed description of this data format.

Switch Operating Modes - Message ID 150

This command sets the receiver into production test or normal operating mode.

Table 2-34 contains the input values for the following example:

Sets the receiver to track SV ID 6 on all channels and to collect test mode performance statistics for 30 seconds.

Example:

A0A20007—Start Sequence and Payload Length

961E510006001E—Payload

0129B0B3—Message Checksum and End Sequence

Table 2-34 Switch Operating Modes - Message ID 150

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		96		Decimal 150
Mode	2		1E51		0=normal, 1E51=Testmode1, 1E52=Testmode2, 1E53=Testmode3, 1E54=Testmode4
SvID	2		0006		Satellite to Track
Period	2		001E	seconds	Duration of Track

Payload length: 7 bytes

Note – In GSW3 and GSWLT3, processing this messages puts MaxOffTime and MaxAcqTime to default values. Requires MID 167 after this to restore those to non-default values.

Set TricklePower Parameters - Message ID 151

This message allows the user to set some of the power-saving modes of the receiver.

Table 2-35 contains the input values for the following example:

Sets the receiver into low power modes.

Example: Set receiver into TricklePower at 1 Hz update and 200 ms on-time.

A0A20009—Start Sequence and Payload Length

97000000C8000000C8—Payload

0227B0B3—Message Checksum and End Sequence

Table 2-35 Set Trickle Power Parameters - Message ID 151

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		97		Decimal 151
Push-to-Fix Mode	2		0000		ON = 1, OFF = 0
Duty Cycle	2	*10	00C8	%	% Time ON. A duty cycle of 1000 (100%) means continuous operation.
On-Time[1]	4		000000C8	msec	range 200 - 900 msec

Payload length: 9 bytes

1. On-time of 700, 800, or 900 ms is invalid if an update rate of 1 second is selected.

Computation of Duty Cycle and On-Time

The Duty Cycle is the desired time to be spent tracking. The On-Time is the duration of each tracking period (range is 200 - 900 msec). To calculate the TricklePower update rate as a function of Duty Cycle and On Time, use the following formula:

$$\text{Update Rate} = \frac{\text{On-Time (in sec)}}{\text{Duty Cycle}}$$

Note – It is not possible to enter an on-time > 900 msec.

Following are some examples of selections:

Table 2-36 Example of Selections for TricklePower Mode of Operation

Mode	On Time (ms)	Duty Cycle (%)	Interval Between Updates (sec)
Continuous[1]	200[2]	100	1
TricklePower	200	20	1
TricklePower	200	10	2
TricklePower	300	10	3
TricklePower	500	5	10

1. Continuous duty cycle is activated by setting Duty Cycle to 0 or 100%.
2. When the duty cycle is set to 100%, the value in this field has no effect. Thus, any legal value (100 to 900) may be used.

Table 2-37 Duty Cycles for Supported TricklePower Settings

	Update Rates (sec)									
On-Time (ms)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
200[1]	200	100	67	50	40	33	29	25	22	20
300	300	150	100	75	60	50	43	37	33	30
400	400	200	133	100	80	67	57	50	44	40
500	500	250	167	125	100	83	71	62	56	50
600	600	300	200	150	120	100	86	75	67	60
700	*	350	233	175	140	117	100	88	78	70
800	*	400	267	200	160	133	114	100	89	80
900	*	450	300	225	180	150	129	112	100	90

1. When the duty cycle is set to 100%, the on time has no effect. However, the command parser may still test the value against the 200-600 ms limits permitted for a 1-second cycle time. Therefore, set the on-time value to 200 ms.

Note – Values are in % times 10 as needed for the duty cycle field. For 1 second update rate, on-times greater than 600 ms are not allowed.

Push-to-Fix

In this mode the receiver turns on every cycle period to perform a system update consisting of an RTC calibration and satellite ephemeris data collection if required (i.e., a new satellite has become visible) as well as all software tasks to support Snap Start in the event of a Non-Maskable Interrupt (NMI). Ephemeris collection time in general takes 18

to 36 seconds. If ephemeris data is not required then the system re-calibrates and shuts down. In either case, the amount of time the receiver remains off is in proportion to how long it stayed on:

$$\text{Off period} = \frac{\text{On Period}*(1-\text{Duty Cycle})}{\text{Duty Cycle}}$$

The off period has a possible range between 10 and 7200 seconds. The default is 1800 seconds. Push-to-Fix cycle period is set using message MID 167.

Poll Navigation Parameters - Message ID 152

This message requests the receiver to report its current navigation parameter settings. The receiver will respond to this message with message ID 19. Table 2-38 contains the input values for the following example:

Example: Poll receiver for current navigation parameters.

A0A20002—Start Sequence and Payload Length

9800—Payload

0098B0B3—Message Checksum and End Sequence

Table 2-38 Poll Receiver for Navigation Parameters - Message ID 152

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		98		Decimal 152
Reserved	1		00		Reserved

Payload length: 2 bytes

Set UART Configuration - Message ID 165

This message is used to set the protocol, baud rate and port settings on any UART.

Note – This message supports setting up to four UARTs. However, a receiver may not have that many UARTs.

Table 2-39 contains the input values for the following example:

Example: Set port 0 to NMEA with 9600 Baud, 8 data bits, 1 stop bit, no parity. Set port 1 to SiRF binary with 57600 Baud, 8 data bits, 1 stop bit, no parity. Do not configure ports 2 and 3.

Example:

A0A20031—Start Sequence and Payload Length

A50001010000258008010000000100000000E1000801000000FF050500000000000000000FF0505000000000000000000—Payload

0452B0B3—Message Checksum and End Sequence

Table 2-39 Set UART Configuration - Message ID 165

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		A5		Decimal 165
Port[1]	1		00		For UART 0
In Protocol[2]	1		01		For UART 0
Out Protocol	1		01		For UART 0 (Set to in protocol)
Baud Rate[3]	4		00002580		For UART 0
Data Bits[4]	1		08		For UART 0
Stop Bits[5]	1		01		For UART 0
Parity[6]	1		00		For UART 0
Reserved	1		00		For UART 0
Reserved	1		00		For UART 0
Port	1		01		For UART 1
In Protocol	1		00		For UART 1
Out Protocol	1		00		For UART 1
Baud Rate	4		0000E100		For UART 1
Data Bits	1		08		For UART 1
Stop Bits	1		01		For UART 1
Parity	1		00		For UART 1
Reserved	1		00		For UART 1
Reserved	1		00		For UART 1
Port	1		FF		For UART 2
In Protocol	1		05		For UART 2
Out Protocol	1		05		For UART 2
Baud Rate	4		00000000		For UART 2
Data Bits	1		00		For UART 2
Stop Bits	1		00		For UART 2
Parity	1		00		For UART 2
Reserved	1		00		For UART 2
Reserved	1		00		For UART 2
Port	1		FF		For UART 3
In Protocol	1		05		For UART 3
Out Protocol	1		05		For UART 3
Baud Rate	4		00000000		For UART 3
Data Bits	1		00		For UART 3
Stop Bits	1		00		For UART 3
Parity	1		00		For UART 3
Reserved	1		00		For UART 3
Reserved	1		00		For UART 3

Payload length: 49 bytes

1. 0xFF means to ignore this port; otherwise, put the port number in this field (e.g., 0 or 1).
2. 0 = SiRF Binary, 1 = NMEA, 2 = ASCII, 3 = RTCM, 4 = User1, 5 = No Protocol.
3. Valid values are 1200, 2400, 4800, 9600, 19200, 38400, and 57600.
4. Valid values are 7 and 8.
5. Valid values are 1 and 2.
6. 0 = None, 1 = Odd, 2 = Even.

Note – While this message supports four UARTs, the specific baseband chip in use may contain fewer.

Set Message Rate - Message ID 166

This message is used to control the output rate of binary messages. Table 2-40 contains the input values for the following example:

Set MID 2 to output every 5 seconds starting immediately.

Example:

A0A20008—Start Sequence and Payload Length

A600020500000000—Payload

00ADB0B3—Message Checksum and End Sequence

Table 2-40 Set Message Rate - Message ID 166

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		A6		decimal 166
Send Now[1]	1		00		Poll message; 0 = No, 1 = Yes
MID to be set	1		02		
Update Rate[2]	1		05	sec	Range = 0 - 30
Reserved	1		00		Not used, set to zero
Reserved	1		00		No used, set to zero
Reserved	1		00		Not used, set to zero
Reserved	1		00		Not used, set to zero

Payload Length: 8 bytes

1. 0 = No, set update rate; 1 = Yes, poll message now and ignore update rate.
2. A value of 0 means to stop sending the message. A value in the range of 1 - 30 specifies the cycle period.

Set Low Power Acquisition Parameters - Message ID 167

This message provides tools to set MaxOffTime, MaxSearchTime, Push-To-Fix period and Adaptive Trickle Power. These settings affect low-power modes as follows:

MaxOffTime: (used in Trickle Power modes only) when the receiver fails to reacquire for a Trickle Power cycle, it returns to sleep mode for this time before it tries again.

MaxSearchTime: in Trickle Power and Push-To-Fix modes, when the receiver is unable to reacquire at the start of a cycle, this parameter sets how long it will try. After this time expires the unit will return to sleep mode for MaxOffTime (if in Trickle Power or ATP mode) or Push-To-Fix cycle time (in Push-To-Fix mode).

Table 2-41 contains the input values for the following example:

Set maximum time for sleep mode and maximum satellite search time to default values. Also set Push-to-Fix cycle time to 60 seconds and disable Adaptive TricklePower.

Example:

A0A2000F—Start Sequence and Payload Length

A7000075300001D4C00000003C0000—Payload

031DB0B3—Message Checksum and End Sequence

Table 2-41 Set Low Power Acquisition Parameters - Message ID 167

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		A7		Decimal 167
Max Off Time	4		00007530	msec	Maximum time for sleep mode. Default value: 30 seconds.
Max Search Time	4		0001D4C0	msec	Max. satellite search time. Default value: 120 seconds.
Push-to-Fix Period	4		0000003C	sec	Push-to-Fix cycle period
Adaptive TricklePower	2		0001		To enable Adaptive TricklePower 0 = off; 1 = on

Payload length: 15 bytes

Poll Command Parameters - Message ID 168

This command queries the receiver to send specific response messages for one of the following messages: 0x80, 0x85, 0x88, 0x89, 0x8A, 0x8B, 0x8C, 0x8F, 0x97 and 0xAA (see Table 2-1 message ID 168).

Table 2-42 contains the input values for the following example:

Query the receiver for current settings of low power parameters set by MID 0x97.

Example:

A0A20002–Start Sequence and Payload Length

A897-Payload

013FB0B3-Message Checksum and End Sequence

Table 2-42 Poll Command Parameters - Message ID 168

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		A8		Decimal 168
Poll Msg ID	1		97		Requesting Msg ID 0x97[1]

Payload length: 2 bytes

1. Valid message IDs are 0x80, 0x85, 0x88, 0x89, 0x8A, 0x8B, 0x8C, 0x8F, 0x97, and 0xAA.

Set SBAS Parameters - Message ID 170

This command allows the user to set the SBAS parameters.

Table 2-43 contains the input values for the following example:

Set automatic SBAS search and testing operating mode.

Example:

A0A20006—Start Sequence and Payload Length

AA0000010000—Payload

01B8B0B3—Message Checksum and End Sequence

Table 2-43 Set SBAS Parameters - Message ID 170

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		AA		Decimal 170
SBAS PRN	1		00		0=Auto mode PRN 120-138= Exclusive
SBAS Mode	1		00		0=Testing, 1=Integrity Integrity mode will reject SBAS corrections if the SBAS satellite is transmitting in a test mode. Testing mode will accept/use SBAS corrections even if satellite is transmitting in a test mode.
Flag Bits[1]	1		01		Bit 0: Timeout; 0=Default 1=User Bit 1: Health; Reserved Bit 2: Correction; Reserved Bit 3: SBAS PRN; 0=Default 1=User
Spare	2		0000		

Payload length: 6 bytes

1. If Bit 0 = 1, user-specified timeout from message ID 138 is used. If Bit 0 = 0, timeout specified by the SBAS satellite will be used (this is usually 18 seconds). If Bit 3 = 1, the SBAS PRN specified in the SBAS PRN field will be used. If Bit 3 = 0, the system will search for any SBAS PRN.

Initialize GPS/DR Navigation - Message ID 172 (Sub ID 1)

Set the navigation initialization parameters and command a software reset based on those parameters.

Name	Bytes	Scale	Units	Description
MID	1			=0xAC
Sub ID	1			=0x01
Latitude	4		deg	for Warm Start with user input.
Longitude	4		deg	for Warm Start with user input.
Altitude (ellipsoid)	4		m	for Warm Start with user input.
True heading	2		deg	for Warm Start with user input.
Clock drift	4		Hz	for Warm Start with user input.
GPS time of week	4	100	sec	for Warm Start with user input.
GPS week number	2			for Warm Start with user input.
Channel count	1			for Warm Start with user input.
Reset configuration bits[1]	1			Bit 0: use initial data provided in this message for start-up. Bit 1: clear ephemeris in memory. Bit 2: clear all memory. Bit 3: perform Factory Reset. Bit 4: enable SiRF Binary output messages for raw track data, navigation library, 50 bps info, RTCM data, clock status, and DR status. Bit 5: enable debug output messages. Bit 6: Reserved. Bit 7: Reserved.

Payload length: 28 bytes

1. Bits 0 - 3 determine the reset mode: 0000=Hot; 0010=Warm; 0011=Warm with user input; 0100=Cold; 1000=Factory.

Set GPS/DR Navigation Mode - Message ID 172 (Sub ID 2)

Set the GPS/DR navigation mode control parameters.

Name	Bytes	Description
MID	1	=AC
Sub ID	1	=0x02
Mode	1	Bit 0 : GPS-only navigation. Bit 1 : DR nav acceptable with stored/default calibration. Bit 2 : DR nav acceptable with current GPS calibration. Bit 3 : DR-only navigation.
Reserved	1	

Set DR Gyro Factory Calibration - Message ID 172 (Sub ID 3)

Set DR gyro factory calibration parameters.

Name	Bytes	Scale	Units	Description
MID	1			=0xAC
Sub ID	1			=0x03
Calibration	1			Bit 0 : Start gyro bias calibration. Bit 1 : Start gyro scale factor calibration. Bits 2 - 7 : Reserved.
Reserved	1			

Payload length: 4 bytes

Set DR Sensors' Parameters - Message ID 172 (Sub ID 4)

Set DR sensors parameters.

Name	Bytes	Scale	Units	Description
MID	1			=0xAC
Sub ID	1			=0x04
Base speed scale factor	1		ticks/m	
Base gyro bias	2	10^4	mV	
Base gyro scale factor	2	10^3	mV/deg/s	

Payload length: 7 bytes

Poll DR Gyro Factory Calibration - Message ID 172 (Sub ID 6)

Poll the DR gyro factory calibration status.

Name	Bytes	Description
MID	1	=AC
Sub ID	1	=0x06

Payload length: 2 bytes

Poll DR Sensors' Parameters - Message ID 172 (Sub ID 7)

Poll the DR sensors parameters.

Name	Bytes	Description
MID	1	=AC
Sub ID	1	=0x07

Payload length: 2 bytes

Marketing Software Configuration - Message ID 180

Note – This message ID 180 is used only with GSC2xr chip.

This input message overrides the Marketing Software Configuration as defined in bits [3:2] of the GSC2xr chip configuration register. The valid input values mapped to the Marketing Software Configuration are described in Table 2-44.

Table 2-44 Valid Input Values

Mapping	
Input Values	Marketing Software Configuration
0	1
1	2
2	3
3	4
4	Standard GSW2 and GSW2x software default configuration[1]

1. The default configuration is SiRF Binary at 38400 bps using UART A and RTCM at 9600 bps using UART B.

Table 2-45 contains the input values for the following example:

Set receiver to Standard GSW2 Default Configuration.

Example:

A0A20002—Start Sequence and Payload Length

B404—Payload

00B8B0B3—Message Checksum and End Sequence

Table 2-45 GSC2xr Marketing Software Configuration - Message ID 180

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		B4		Decimal 180
Input[1]	1		04		Valid input value from 0 to 4

Payload length: 2bytes

1. Invalid input value will yield a Rejected MID_UserInputBegin while a valid input value will yield a Acknowledged MID_UserInputBegin response in the SiRFDemo response view.

Table 2-46 GSC2xr Marketing Software Configurations

New Config	Nav Status	Config 4	Config 3	Config 2	Config 1
UARTA		NMEA v2.2	NMEA v2.2	SiRF Binary	NMEA v2.2
UARTB		RTCM	RTCM	NMEA v2.2	SiRF Binary
Build		GSWx2.4.0 and greater	GSWx2.4.0 and greater	GSWx2.4.0 and greater	GSWx2.4.0 and greater, Adaptive TricklePower @ 300,1
UARTA Baud		4800 n, 8, 1	19200 n, 8, 1	57600 n, 8, 1	4800 n, 8, 1
UARTB Baud		9600 n, 8, 1	9600 n, 8, 1	115200 n, 8, 1	38400 n, 8, 1
SiRF Binary Output Messages[1]		2, 4, 9, 13, 18, 27, 41, 52	2, 4, 9, 13, 18, 27, 41, 52	2, 4, 9, 13, 18, 27, 41, 52	2, 4, 9, 13, 18, 27, 41, 52
NMEA Messages		RMC, GGA, VTG, GSA (GSV@ 1/5Hz), ZDA	GGA, GLL, GSA, GSV, RMC, VTG, ZDA	GGA, GLL, GSA, GSV, RMC, VTG, ZDA	GGA, GLL, GSA, GSV, RMC, VTG, ZDA
GPIO A (GPIO 1)	No Nav	On	On	On	On
	Nav	100ms on, 1Hz	100ms on, 1Hz	100ms on, 1Hz	100ms on, 1Hz
GPIO B (GPIO 3)	No Nav	Off	Off	Off	Off
	Nav	100ms on, 1Hz	100ms on, 1Hz	100ms on, 1Hz	100ms on, 1Hz
GPIO C (GPIO 13)	No Nav	On	On	On	On
	Nav	1s on, 1s off	1s on, 1s off	1s on, 1s off	1s on, 1s off
GPIO D (GPIO 2)	No Nav	Off	Off	Off	Off
	Nav	On	On	On	On
Static Filter		Off	Off	Off	Off
Track Smoothing		On	On	On	On
WAAS		Disabled	Enabled	Enabled	Disabled
DR		Off	Off	Off	Off

1. SiRF Binary Messages: 2 - Measured Nav Data, 4 - Measured Track Data, 9 - Through Put, 13 - Visible List, 18 - OK to Send, 27 - DGPS Status

41 - Geodetic Nav Data, 52 - 1 PPS Time Message.

Reserved - Message ID 228

This input message is SiRF proprietary.

Extended Ephemeris - Message ID 232

Message ID 232 is used by GSW2 (2.5 or above), SiRFXTrac (2.3 or above), and GSW3 (3.2.0 or above), and GSWLT3 software. This message has two sub IDs.

Table 2-47 Extended Ephemeris - Message ID 232

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		E8			232
Message Sub ID	1		01			1

Payload length: variable (2 bytes + Sub ID payload bytes)

Extended Ephemeris Proprietary - Message ID 232 (Sub ID 1)

Output Rate: Depending on the Client Location Manager (CLM)

Example:

A0A201F6—Start Sequence and Payload Length

Table 2-48 Extended Ephemeris - Message ID 232 (Sub ID 1)

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		E8			232
Message Sub ID	1		01			1
SiRF Proprietary Ephemeris Format	500					Content not disclosed

Payload length: 502 bytes

Extended Ephemeris Debug - Message ID 232 (Sub ID 255)

Example:

A0A20006—Start Sequence and Payload Length

E8FF01000000 – Payload

01E8B0B3—Message Checksum and End Sequence

Table 2-49 Extended Ephemeris - Message ID 232 (Sub ID 255)

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		E8			232
Message Sub ID	1		FF			255
DEBUG_FLAG	4		0x01000000			

Payload length: 6 bytes

Table 2-50 Detailed Description of Extended Ephemeris Debug Parameters

Name	Description
Message ID	Message ID number.
Message Sub ID	Message Sub ID number.
DEBUG_FLAG	If the first byte is set to 0x01 (i.e. Debug_Flag = 0x01000000), the GPS sensor ignores all internal broadcast ephemeris.

Output Messages 3

This chapter provides information about available SiRF Binary output messages. For each message, a full definition and example is provided.

Table 3-1 SiRF Binary Messages - Output Message List

Hex	Decimal	Name	Description
01	1	Reference Navigation Data	Not Implemented
02	2	Measured Navigation Data	Position, velocity, and time
03	3	True Tracker Data	Not Implemented
04	4	Measured Tracking Data	Satellite and C/No information
05	5	Raw Track Data	Not supported by SiRFstarII
06	6	SW Version	Receiver software
07	7	Clock Status	Current clock status
08	8	50 BPS Subframe Data	Standard ICD format
09	9	Throughput	Navigation complete data
0A	10	Error ID	Error coding for message failure
0B	11	Command Acknowledgment	Successful request
0C	12	Command NAcknowledgment	Unsuccessful request
0D	13	Visible List	Auto Output
0E	14	Almanac Data	Response to poll
0F	15	Ephemeris Data	Response to poll
10	16	Test Mode 1	For use with SiRFtest (Test Mode 1)
11	17	Differential Corrections	Received from DGPS broadcast
12	18	OkToSend	CPU ON / OFF (TricklePower)
13	19	Navigation Parameters	Response to Poll
14	20	Test Mode 2/3/4	Test Mode 2, 3, or 4 test data
1B	27	DGPS Status	Differential GPS status information
1C	28	Nav. Lib. Measurement Data	Measurement data
1D	29	Nav. Lib. DGPS Data	Differential GPS data
1E	30	Nav. Lib. SV State Data	Satellite state data
1F	31	Nav. Lib. Initialization Data	Initialization data
29	41	Geodetic Navigation Data	Geodetic navigation information
2B	43	Queue Command Parameters	Command parameters
2D	45	Raw DR Data	Raw DR data from ADC
2E	46	Test Mode 3	Additional test data (Test Mode 3)
30	48[1]	Test Mode 4 for SiRFLoc v2.x only	Additional test data (Test Mode 4)
30	48	SiRFDRive-specific Class of Output Messages	The MID is partitioned into messages identified by Sub IDs, refer to Table 3-2
31	49	Test Mode 4 for SiRFLoc v2.x only	Additional test data (Test Mode 4)

Table 3-1 SiRF Binary Messages - Output Message List *(Continued)*

Hex	Decimal	Name	Description
32	50	SBAS Parameters	SBAS operating parameters
34	52	1 PPS Time Message	Time message for 1 PPS
37	55	Test Mode 4	Track Data
38	56	Extended Ephemeris Data	Extended Ephemeris Mask and Integrity Information
E1	225	SiRF internal message	Reserved
FF	255	Development Data	Various status messages

1. This message ID 48 for Test Mode 4 is not to be confused with message ID 48 for DR Navigation. SiRFLoc Message ID 48 will be transferred to a different message ID in the near future.

Table 3-2 Sub IDs for SiRFDRive output MID 48 (0x30)

Sub ID	Message
1	DR Navigation Status
2	DR Navigation State
3	Navigation Subsystem
4	Raw DR Data
5	DR Validity (not implemented)
6	DR Gyro Factory Calibration
7	DR Sensors Parameters
8	DR Data Block

Since the SiRF Binary protocol is evolving along with continued development of SiRF software and GPS solutions, not all SiRF Binary messages are supported by all SiRF GPS solutions.

Table 3-3 identifies the supported output messages for each SiRF architecture.

Table 3-3 Supported Output Messages

	SiRF Software Options				
Message ID	GSW2	SiRFDRive	SiRFXTrac	SiRFLoc	GSW3 GSWLT3
1	Yes	Yes	No	No	No
2	Yes	Yes	Yes	Yes	Yes
3	No	No	No	No	No
4	Yes	Yes	Yes	Yes	Yes
5	No	No	No	No	No
6	Yes	Yes	Yes	Yes	Yes
7	Yes	Yes	Yes	Yes	Yes
8	Yes	Yes	Yes	Yes	Yes
9	Yes	Yes	Yes	Yes	Yes (GSW3) No (GSWLT3)
10	Yes	Yes	Yes	Yes	Yes
11	Yes	Yes	Yes	Yes	Yes
12	Yes	Yes	Yes	Yes	Yes
13	Yes	Yes	Yes	Yes	Yes
14	Yes	Yes	No	Yes	Yes
15	Yes	Yes	No	Yes	Yes
16	Yes	Yes	No	No	No
17	Yes	Yes	No	No	No

Table 3-3 Supported Output Messages *(Continued)*

Message ID	SiRF Software Options				
	GSW2	**SiRFDRive**	**SiRFXTrac**	**SiRFLoc**	**GSW3 GSWLT3**
18	Yes	Yes	Yes	Yes	Yes
19	Yes	Yes	Yes	Yes	Yes
20	Test Mode 2 only	Test Mode 2 only	Test Mode 2/3/4	Test Mode 4 (2.x only)	No
27	Yes	Yes	No	No	Yes
28	Yes	Yes	No	No	Yes
29	Yes	Yes	No	No	No
30	Yes	Yes	No	No	Yes
31	Yes	Yes	No	No	Yes
41	2.3 or above	Yes	2.0 or above	No	Yes
43	No	No	No	No	Yes
45	No	Yes	No	No	No
46	Yes	Yes	No	Yes (3.x and above)	Yes
48[1] (TestMode4)	No	No	No	Yes (2.x only)	No
48 (DR)	No	Yes	No	No	No
50	2.3 or above	Yes	No	No	No
52	2.3.2 or above	No	No	No	No
55	No	No	No	Yes (3.x and above)	Yes
56	2.5 or above	No	2.3 or above	No	3.2.0 or above
225	No	No	No	No	Yes (reserved)
232	No	No	No	No	Yes
255	Yes	Yes	Yes	Yes	Yes

1. This message ID 48 for Test Mode 4 is not to be confused with message ID 48 for DR Navigation. Message ID 48 for SiRFLoc will be transferred to a different message ID in the near future.

Reference Navigation Data - Message ID 1

This message is defined as Reference Navigation data but has not been implemented.

Measure Navigation Data Out - Message ID 2

Output Rate: 1 Hz

Table 3-4 lists the message data format for the measured navigation data.

Example:

A0A20029—Start Sequence and Payload Length

02FFD6F78CFFBE536E003AC00400000030001040A00036B039780E3
0612190E160F04000000000000—Payload

09BBB0B3—Message Checksum and End Sequence

Table 3-4 Measured Navigation Data Out - Message ID 2

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		02			2
X-position	4		FFD6F78C	m		-2689140
Y-position	4		FFBE536E	m		-4304018
Z-position	4		003AC004	m		3850244
X-velocity	2	*8	0000	m/sec	Vx÷8	0
Y-velocity	2	*8	0003	m/sec	Vy÷8	0.375
Z-velocity	2	*8	0001	m/sec	Vz÷8	0.125
Mode 1	1		04	Bitmap[1]		4
HDOP[2]	1	*5	0A		÷5	2.0
Mode 2	1		00	Bitmap[3]		0
GPS Week[4]	2		036B			875
GPS TOW	4	*100	039780E3	seconds	÷100	602605.79
SVs in Fix	1		06			6
CH 1 PRN[5]	1		12			18
CH 2 PRN[5]	1		19			25
CH 3 PRN[5]	1		0E			14
CH 4 PRN[5]	1		16			22
CH 5 PRN[5]	1		0F			15
CH 6 PRN[5]	1		04			4
CH 7 PRN[5]	1		00			0
CH 8 PRN[5]	1		00			0
CH 9 PRN[5]	1		00			0
CH 10 PRN[5]	1		00			0
CH 11 PRN[5]	1		00			0
CH 12 PRN[5]	1		00			0

Payload length: 41 bytes

1. For further information see Table 3-5 and Table 3-6.
2. HDOP value reported has a maximum value of 50.
3. For further information see Table 3-7.
4. GPS week reports only the ten LSBs of the actual week number.
5. PRN values are reported only for satellites used in the navigation solution.

Note – Binary units scaled to integer values must be divided by the scale value to receive true decimal value (i.e., decimal X_{vel} = binary $X_{vel} \div 8$).

Mode 1 of Message ID 2 is a bit-mapped byte with five sub-values. Table 3-5 shows the location of the sub-values while Table 3-6 shows the interpretation of each sub-value

Table 3-5 Mode 1

Bit	7	6	5	4	3	2	1	0
Bit(s) Name	DGPS	DOP-Mask	ALTMODE		TPMODE	PMODE		

Table 3-6 Mode 1 Bitmap Information

Bit(s) Name	Name	Value	Description
PMODE	Position mode	0	No navigation solution
		1	1-SV solution (Kalman filter)
		2	2-SV solution (Kalman filter)
		3	3-SV solution (Kalman filter)
		4	> 3-SV solution (Kalman filter)
		5	2-D point solution (least squares)
		6	3-D point solution (least squares)
		7	Dead-Reckoning[1] solution (no satellites)
TPMODE	TricklePower mode	0	Full power position
		1	TricklePower position
ALTMODE	Altitude mode	0	No altitude hold applied
		1	Holding of altitude from KF
		2	Holding of altitude from user input
		3	Always hold altitude (from user input)
DOPMASK	DOP mask status	0	DOP mask not exceeded
		1	DOP mask exceeded
DGPS	DGPS status	0	No differential corrections applied
		1	Differential corrections applied

1. In standard software, Dead Reckoning solution is computed by taking the last valid position and velocity and projecting the position using the velocity and elapsed time.

Mode 2 of Message ID bit-mapped byte information is described in Table 3-7.

Table 3-7 Mode 2 Bitmap

Bit	Description
0	1 = sensor DR in use 0 = velocity DR if PMODE sub-value in Mode 1 = 7; else check Bits 6 and 7 for DR error status
1	If set, solution is validated (5 or more SVs used)[1]
2	If set, velocity DR timeout
3	If set, solution edited by UI (e.g., DOP Mask exceeded)
4	If set, velocity is invalid
5	Altitude hold mode: 0 = enabled 1 = disabled (3-D fix only)
7,6	Sensor DR error status: 00 = GPS-only navigation 01 = DR in calibration 10 = DR sensor errors 11 = DR in test mode

1. From an unvalidated state, a 5-SV fix must be achieved to become a validated position. If the receiver continues to navigate in a degraded mode (less than 4 SVs), the validated status will remain. If navigation is lost completely, an unvalidated status will result.

Note – Mode 2 of MID 2 is used to define the Fix field of the Measured Navigation Message View. It should be used only as an indication of the current fix status of the navigation solution and not as a measurement of TTFF.

True Tracker Data - Message ID 3

This message is defined as True Tracker data but has not been implemented.

Measured Tracker Data Out - Message ID 4

Output Rate: 1 Hz

Table 3-8 lists the message data format for the measured tracker data.

Example:

A0A200BC—Start Sequence and Payload Length

04036C0000937F0C0EAB46003F1A1E1D1D191D1A1A1D1F1D59423F1A1A...—Payload

....B0B3—Message Checksum and End Sequence

Table 3-8 Measured Tracker Data Out - Message ID 4

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		04			4
GPS Week[1]	2		036C			876
GPS TOW	4	s*100	0000937F	sec	s÷100	37759
Chans	1		0C			12
1st SVid	1		0E			14
Azimuth	1	Az*[2/3]	AB	deg	÷[2/3]	256.5
Elev	1	El*2	46	deg	÷2	35
State	2		003F	Bitmap[2]		0 x 3F
C/No 1	1		1A	dB-Hz		26
C/No 2	1		1E	dB-Hz		30
C/No 3	1		1D	dB-Hz		29
C/No 4	1		1D	dB-Hz		29
C/No 5	1		19	dB-Hz		25
C/No 6	1		1D	dB-Hz		29
C/No 7	1		1A	dB-Hz		26
C/No 8	1		1A	dB-Hz		26
C/No 9	1		1D	dB-Hz		29
C/No 10	1		1F	dB-Hz		31
2nd SVid	1		1D			29
Azimuth	1	Az*[2/3]	59	deg	÷[2/3]	89
Elev	1	El*2	42	deg	÷2	66
State	2		3F	Bitmap[2]		63

Table 3-8 Measured Tracker Data Out - Message ID 4 *(Continued)*

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
C/No 1	1		1A	dB-Hz		26
C/No 2	1		1A	dB-Hz		63
...						
SVid, Azimuth, Elevation, State, and C/No 1-10 values are repeated for each of the 12 channels						

Payload length: 188 bytes

1. GPS week number is reported modulo 1024 (ten LSBs only).
2. For further information, see Table 3-9 for state values for each channel.

Table 3-9 State Values for Each Channel

Bit	Description When Bit is Set to 1
0x0001	Acquisition/re-acquisition has been completed successfully
0x0002	The integrated carrier phase is valid - delta range in MID 28 is also valid
0x0004	Bit synchronization has been completed
0x0008	Subframe synchronization has been completed
0x0010	Carrier pullin has been completed (Costas lock)
0x0020	Code has been locked
0x0040	Satellite acquisition has failed
0x0080	Ephemeris data is available

Raw Tracker Data Out - Message ID 5

This message is not supported by the SiRFstarII or SiRFstarIII architecture.

Software Version String (Response to Poll) - Message ID 6

This message has a variable length from 1 to 81 bytes.

Output Rate: Response to polling message

Example:

A0A20015—Start Sequence and Payload Length

06322E332E322D475358322D322E30352E3032342D4331464C4558312E32000000
00000000000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000—Payload

0631B0B3—Message Checksum and End Sequence

Table 3-10 Software Version String - Message ID 6

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		06			6
Character	80		[1]			[2]

Payload Length: 1-81 bytes

1. Repeat the payload sequence above minus the starting 0x06 byte.
2. 2.3.2-GSW2-2.05.024-C1FLEX1.2

Note – Convert ASCII to symbol to assemble message (i.e., 0x4E is ‘N’). This is a low priority task and is not necessarily output at constant intervals. Effective with version GSW 2.3.2, message length was increased from 21 to 81 bytes to allow for up to 80-character version string.

Response: Clock Status Data - Message ID 7

Output Rate: 1 Hz or response to polling message

Example:

A0A20014—Start Sequence and Payload Length

0703BD02154924080001223100004728 14D4DAEF—Payload

0598B0B3—Message Checksum and End Sequence

Table 3-11 Clock Status Data - Message ID 7

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		07			7
Extended GPS Week[1]	2		03BD			957
GPS TOW	4	*100	02154924	sec	÷100	349494.12
SVs[2]	1		08			8
Clock Drift	4		00012231	Hz		74289
Clock Bias	4		00004728	ns		18216
Estimated GPS Time	4		14D4DAEF	ms		349493999

Payload length: 20 bytes

1. GPS week has been resolved to the full week number (1024-week ambiguity has been resolved).
2. Number of satellites used in the solution for clock drift, clock bias, and estimated GPS time.

50 BPS Data - Message ID 8

Output Rate: Approximately every 6 seconds for each channel

Example:

A0A2002B—Start Sequence and Payload Length

08001900C0342A9B688AB0113FDE2D714FA0A7FFFACC5540157EFFEEDFFFA8 0365A867FC67708BEB5860F4—Payload

15AAB0B3—Message Checksum and End Sequence

Table 3-12 50 BPS Data - Message ID 8

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		08			8
Channel	1		00			0
SV ID	1		19			25
Word[10]	40					

Payload length: 43 bytes per sub-frame (5 subframes per page)

Note – Data is logged in ICD-GPS-200C format (available from www.navcen.uscg.mil). The 10 words together comprise a complete subframe of navigation message data. Within the word, the 30 bits of the navigation message word are right justified, complete with 24 data bits and 6 parity bits. Any inversion of the data has not been removed. The 2 MSBs of the word contain parity bits 29 and 30 from the previous navigation message word.

CPU Throughput - Message ID 9

Output Rate: 1 Hz

Example:

A0A20009—Start Sequence and Payload Length

09003B0011001601E5—Payload

0151B0B3—Message Checksum and End Sequence

Table 3-13 CPU Throughput - Message ID 9

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		09			9
SegStatMax	2	*186	003B	ms	÷186	0.3172
SegStatLat	2	*186	0011	ms	÷186	0.0914
AveTrkTime	2	*186	0016	ms	÷186	0.1183
Last Millisecond	2		01E5	ms		485

Payload length: 9 bytes

Error ID Data - Message ID 10

Output Rate: As errors occur

MID 10 messages have a different format from other messages. Rather than one fixed format, there are several formats, each designated by an error ID. However, the format is standardized as indicated in Table 3-14. The specific format of each error ID message follows.

Table 3-14 Message ID 10 Overall Format

Name	Bytes	Description
Message ID	1	Message ID number - 10.
Error ID	2	Sub-message type.
Count	2	Count of number of 4-byte values that follow.
Data[n]	4 * n	Actual data for the message, *n* is equal to Count.

Error ID: 2

Code Define Name: ErrId_CS_SVParity

Error ID Description: Satellite subframe # failed parity check.

Example:

A0A2000D – Start Sequence and Payload Length

0A0002000200000001000000002 – Payload

0011B0B3 – Message Checksum and End Sequence

Table 3-15 Error ID

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		0002			2
Count	2		0002			2
Satellite ID	4		00000001			1
Subframe No	4		00000002			2

Payload Length: 13 bytes

Table 3-16 Error ID 2 Message Description

Name	Description
Message ID	Message ID number.
Error ID	Error ID (see Error ID description above).
Count	Number of 32 bit data in message.
Satellite ID	Satellite pseudo-random noise (PRN) number.
Subframe No	The associated subframe number that failed the parity check. Valid subframe number is 1 through 5.

Error ID: 9

Code Define Name: ErrId_RMC_GettingPosition

Error ID Description: Failed to obtain a position for acquired satellite ID.

Example:

A0A20009 – Start Sequence and Payload Length

0A0009000100000001 – Payload

0015B0B3 – Message Checksum and End Sequence

Table 3-17 Error ID 9 Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		0009			9
Count	2		0002			2
Satellite ID	4		00000001			1

Payload Length: 9 bytes

Table 3-18 Error ID 9 Message Description

Name	Description
Message ID	Message ID number.
Error ID	Error ID (see Error ID description above).
Count	Number of 32 bit data in message.
Satellite ID	Satellite pseudo-random noise number.

Error ID: 10

Code Define Name: ErrId_RXM_TimeExceeded

Error ID Description: Conversion of Nav Pseudo Range to Time of Week (TOW) for tracker exceeds limits: Nav Pseudo Range > 6.912e5 (1 week in seconds) || Nav Pseudo Range < -8.64e4.

Example:

A0A20009 – Start Sequence and Payload Length

0A000A000100001234 – Payload

005BB0B3 – Message Checksum and End Sequence

Table 3-19 Error ID 10 Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		000A			10
Count	2		0001			1
Pseudorange	4		00001234			4660

Payload length: 9 bytes

Table 3-20 Error ID 10 Message Description

Name	Description
Message ID	Message ID number.
Error ID	Error ID (see Error ID description above).
Count	Number of 32 bit data in message.
Pseudorange	Pseudo range.

Error ID: 11

Code Define Name: ErrId_RXM_TDOPOverflow

Error ID Description: Convert pseudorange rate to Doppler frequency exceeds limit.

Example:

A0A20009 – Start Sequence and Payload Length

0A000B0001xxxxxxxx – Payload

xxxxB0B3 – Message Checksum and End Sequence

Table 3-21 Error ID 11 Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		000B			11
Count	2		0001			1
Doppler Frequency	4		xxxxxxxx			xxxxxxxx

Payload length: 9 bytes

Table 3-22 Error ID 11 Message Description

Name	Description
Message ID	Message ID number.
Error ID	Error ID (see Error ID description above).
Count	Number of 32 bit data in message.
Doppler Frequency	Doppler frequency.

Error ID: 12

Code Define Name: ErrId_RXM_ValidDurationExceeded

Error ID Description: Satellite ephemeris age has exceeded 2 hours (7200 s).

Example:

A0A2000D – Start Sequence and Payload Length

0A000C0002xxxxxxxxaaaaaaaa – Payload

xxxxB0B3 – Message Checksum and End Sequence

Table 3-23 Error ID 12 Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		000C			12
Count	2		0002			2
Satellite ID	4		xxxxxxxx			xxxxxxxx
Age Of Ephemeris	4		aaaaaaaa	seconds		aaaaaaaa

Payload Length: 13 bytes

Table 3-24 Error ID 12 Message Description

Name	Description
Message ID	Message ID number.
Error ID	Error ID (see Error ID description above).
Count	Number of 32 bit data in message.
Satellite ID	Satellite pseudo-random noise number
Age of Ephemeris	The satellite ephemeris age in seconds.

Error ID: 13

Code Define Name: ErrId_STRTP_BadPostion

Error ID Description: SRAM position is bad during a cold start.

Example:

A0A20011 – Start Sequence and Payload Length

0A000D0003xxxxxxxxaaaaaaaabbbbbbbb – Payload

xxxxB0B3 – Message Checksum and End Sequence

Table 3-25 Error ID 13 Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		000D			13
Count	2		0003			3
X	4		xxxxxxxx			xxxxxxxx
Y	4		aaaaaaaa			aaaaaaaa
Z	4		bbbbbbbb			bbbbbbbb

Payload length: 17 bytes

Table 3-26 Error ID 13 Message Description

Name	Description
Message ID	Message ID number.
Error ID	Error ID (see Error ID description above).
Count	Number of 32 bit data in message.
X	X position in ECEF.
Y	Y position in ECEF.
Z	Z position in ECEF.

Error ID: 4097 (0x1001)

Code Define Name: ErrId_MI_VCOClockLost

Error ID Description: VCO lost lock indicator.

Example:

A0A20009 – Start Sequence and Payload Length

0A1001000100000001 – Payload

001DB0B3 – Message Checksum and End Sequence

Table 3-27 Error ID 4097 Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		1001			4097
Count	2		0001			1
VCOLost	4		00000001			1

Payload length: 9 bytes

Table 3-28 Error ID 4097 Message Description

Name	Description
Message ID	Message ID number.
Error ID	Error ID (see Error ID description above).
Count	Number of 32 bit data in message.
VCOLost	VCO lock lost indicator. If VCOLost != 0, then send failure message.

Error ID: 4099 (0x1003)

Code Define Name: ErrId_MI_FalseAcqReceiverReset

Error ID Description: Nav detect false acquisition, reset receiver by calling NavForceReset routine.

Example:

A0A20009 – Start Sequence and Payload Length

0A1003000100000001 – Payload

001FB0B3 – Message Checksum and End Sequence

Table 3-29 Error ID 4099 Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		1003			4099
Count	2		0001			1
InTrkCount	4		00000001			1

Payload Length: 9 bytes

Table 3-30 Error ID 4099 Message Description

Name	Description
Message ID	Message ID number.
Error ID	Error ID (see Error ID description above).
Count	Number of 32 bit data in message.
InTrkCount	False acquisition indicator. If InTrkCount <= 1, then send failure message and reset receiver.

Error ID: 4104 (0x1008)

Code Define Name: ErrId_STRTP_SRAMCksum

Error ID Description: Failed SRAM checksum during startup.

- Four field message indicates receiver control flags had checksum failures.
- Three field message indicates clock offset's checksum failure or clock offset value is out of range.
- Two field message indicates position and time checksum failure forces a cold start.

Example:

A0A2xxxx – Start Sequence and Payload Length

0A10080004xxxxxxxaaaaaaaa00000000cccccccc – Payload

xxxxB0B3 – Message Checksum and End Sequence

Table 3-31 Error ID 4104 Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		1008			4104
Count	2		0004 or 0003 or 0002			4 or 3 or 2
Computed Receiver Control Checksum	4		xxxxxxxx			xxxx
Battery-Backed Receiver Control Checksum	4		aaaaaaaa			aaaa
Battery-Backed Receiver Control OpMode	4		00000000			0
Battery-Backed Receiver Control Channel Count	4		cccccccc			cccc
Compute Clock Offset Checksum	4		xxxxxxxx			xxxx
Battery-Backed Clock Offset Checksum	4		aaaaaaaa			aaaa
Battery-Backed Clock Offset	4		bbbbbbbb			bbbb
Computed Position Time Checksum	4		xxxxxxxx			xxxx
Battery-Backed Position Time Checksum	4		aaaaaaaa			aaaa

Payload length: 21, 17, or 11 bytes

Table 3-32 Error ID 4104 Message Description

Name	Description
Message ID	Message ID number.
Error ID	Error ID (see Error ID description above).
Count	Number of 32 bit data in message.
Computed Receiver Control Checksum	Computed receiver control checksum of SRAM.Data.Control structure.
Battery-Backed Receiver Control Checksum	Battery-backed receiver control checksum stored in SRAM.Data.DataBuffer. CntrlChkSum.
Battery-Backed Receiver Control OpMode	Battery-backed receiver control checksum stored in SRAM.Data.Control.OpMode. Valid OpMode values are as follows: OP_MODE_NORMAL = 0, OP_MODE_TESTING = 0x1E51, OP_MODE_TESTING2 = 0x1E52, OP_MODE_TESTING3 = 0x1E53.
Battery-Backed Receiver Control Channel Count	Battery-backed receiver control channel count in SRAM.Data.Control.ChannelCnt. Valid channel count values are 0-12.
Compute Clock Offset Checksum	Computed clock offset checksum of SRAM.Data.DataBuffer.clkOffset.
Battery-Backed Clock Offset Checksum	Battery-backed clock offset checksum of SRAM.Data.DataBuffer.clkChkSum.
Battery-Backed Clock Offset	Battery-backed clock offset value stored in SRAM.Data.DataBuffer,clkOffset.
Computed Position Time Checksum	Computed position time checksum of SRAM.Data.DataBuffer.postime[1].
Battery-Backed Position Time Checksum	Battery-backed position time checksum of SRAM.Data.DataBuffer.postimeChkSum[1].

Error ID: 4105 (0x1009)

Code Define Name: ErrId_STRTP_RTCTimeInvalid

Error ID Description: Failed RTC SRAM checksum during startup. If one of the double buffered SRAM.Data.LastRTC elements is valid and RTC days is not 255 days, the GPS time and week number computed from the RTC is valid. If not, this RTC time is invalid.

Example:

A0A2000D – Start Sequence and Payload Length

0A10090002xxxxxxxaaaaaaaa – Payload

xxxxB0B3 – Message Checksum and End Sequence

Table 3-33 Error ID 4105 Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		1009			4105
Count	2		0002			2
TOW	4		xxxxxxxx	seconds		xxxx
Week Number	4		aaaaaaaa			aaaa

Payload length: 13 bytes

Table 3-34 Error ID 4105 Message Description

Name	Description
Message ID	Message ID number.
Error ID	Error ID (see Error ID description above).
Count	Number of 32 bit data in message.
TOW	GPS time of week in seconds. Range 0 to 604800 seconds.
Week Number	GPS week number.

Error ID: 4106 (0x100A)

Code Define Name: ErrId_KFC_BackupFailed_Velocity

Error ID Description: Failed battery-backing position because the ECEF velocity sum was greater than 3600.

Example:

A0A20005 – Start Sequence and Payload Length

0A100A0000 – Payload

0024B0B3 – Message Checksum and End Sequence

Table 3-35 Error ID 4106 Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		100A			4106
Count	2		0000			0

Payload length: 5 bytes

Table 3-36 Error ID 4106 Message Description

Name	Description
Message ID	Message ID number.
Error ID	Error ID (see Error ID description above).
Count	Number of 32 bit data in message.

Error ID: 4107 (0x100B)

Code Define Name: ErrId_KFC_BackupFailed_NumSV

Error ID Description: Failed battery-backing position because current navigation mode is not KFNav and not LSQFix.

Example:

A0A20005 – Start Sequence and Payload Length

0A100B0000 – Payload

0025B0B3 – Message Checksum and End Sequence

Table 3-37 Error ID 4107 Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		100B			4107
Count	2		0000			0

Payload length: 5 bytes

Table 3-38 Error ID 4107 Message Description

Name	Description
Message ID	Message ID number.
Error ID	Error ID (see Error ID description above).
Count	Number of 32 bit data in message.

Error ID: 8193 (0x2001)

Code Define Name: ErrId_MI_BufferAllocFailure

Error ID Description: Buffer allocation error occurred. Does not appear to be active because uartAllocError variable never gets set to a non-zero value in the code.

Example:

A0A20009 – Start Sequence and Payload Length

0A2001000100000001 – Payload

002DB0B3 – Message Checksum and End Sequence

Table 3-39 Error ID 8193 Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		2001			8193
Count	2		0001			1
uartAllocError	4		00000001			1

Payload length: 9 bytes

Table 3-40 Error ID 8193 Message Description

Name	Description
Message ID	Message ID number.
Error ID	Error ID (see Error ID description above).
Count	Number of 32 bit data in message.
uartAllocError	Contents of variable used to signal UART buffer allocation error.

Error ID: 8194 (0x2002)

Code Define Name: ErrId_MI_UpdateTimeFailure

Error ID Description: PROCESS_1SEC task was unable to complete upon entry. Overruns are occurring.

Example:

A0A2000D – Start Sequence and Payload Length

0A2002000200000001000000064 – Payload

0093B0B3 – Message Checksum and End Sequence

Table 3-41 Error ID 8194 Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		2002			8194
Count	2		0002			2
Number of in process errors.	4		00000001			1
Millisecond errors	4		00000064			100

Payload length: 13 bytes

Table 3-42 Error ID 8194 Message Description

Name	Description
Message ID	Message ID number.
Error ID	Error ID (see Error ID description above).
Count	Number of 32 bit data in message.
Number of in process errors	Number of one second updates not complete on entry.
Millisecond errors	Millisecond errors caused by overruns.

Error ID: 8195 (0x2003)

Code Define Name: ErrId_MI_MemoryTestFailed

Error ID Description: Failure of hardware memory test. Does not appear to be active because MemStatus variable never gets set to a non-zero value in the code.

Example:

A0A20005 – Start Sequence and Payload Length

0A20030000 – Payload

002DB0B3 – Message Checksum and End Sequence

Table 3-43 Error ID 8195 Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		2003			8195
Count	2		0000			0

Payload length: 5 bytes

Table 3-44 Error ID 8195 Message Description

Name	Description
Message ID	Message ID number.
Error ID	Error ID (see Error ID description above).
Count	Number of 32 bit data in message.

Command Acknowledgment - Message ID 11

Output Rate: Response to successful input message

This is a successful almanac request (message ID 0x92) example:

A0A20002—Start Sequence and Payload Length

0B92—Payload

009DB0B3—Message Checksum and End Sequence

Table 3-45 Command Acknowledgment - Message ID 11

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0x0B			11
ACK ID	1		0x92			146

Payload length: 2 bytes

Command NAcknowledgment - Message ID 12

Output Rate: Response to rejected input message

This is an unsuccessful almanac request (message ID 0x92) example:

A0A20002—Start Sequence and Payload Length

0C92—Payload

009EB0B3—Message Checksum and End Sequence

Table 3-46 Command N'Acknowledgment - Message ID 12

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0x0C			12
N'Ack ID	1		0x92			146

Payload length: 2 bytes

Note – Commands can be Nack'd for several reasons including: failed checksum, invalid arguments, unknown command, or failure to execute command.

Visible List – Message ID 13

Output Rate: Updated approximately every 2 minutes

Note – This is a variable length message. Only the number of visible satellites are reported (as defined by Visible SVs in Table 3-47).

Example:

A0A2002A—Start Sequence and Payload Length

0D081D002A00320F009C0032....—Payload

....B0B3—Message Checksum and End Sequence

Table 3-47 Visible List - Message ID 13

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0D			13
Visible SVs	1		08			8
Ch 1 - SV ID	1		10			16
Ch 1 - SV Azimuth	2		002A	degrees		42
Ch 1 - SV Elevation	2		0032	degrees		50
Ch 2 - SV ID	1		0F			15
Ch 2 - SV Azimuth	2		009C	degrees		156
Ch 2 - SV Elevation	2		0032	degrees		50
...						

Payload length: variable (2 + 5 times number of visible SVs up to maximum of 62 bytes)

Almanac Data - Message ID 14

Output Rate: Response to poll

Table 3-48 Contents of Message ID 14

Name	Bytes	Description
Message ID	1	Hex 0x0E (decimal 14)
SV ID	1	SV PRN code, hex 0x01..0x02, decimal 1..32
Almanac Week & Status	2	10-bit week number in 10 MSBs, status in 6 LSBs (1 = good; 0 = bad)
Data[1]	24	UINT16[12] array with sub-frame data.
Checksum	2	

Payload length: 30 bytes

1. The data area consists of an array of 12 16-bit words consisting of the data bytes from the navigation message sub-frame. Table 3-49 shows how the actual bytes in the navigation message correspond to the bytes in this data array. Note that these are the raw navigation message data bits with any inversion removed and the parity bits removed.

Table 3-49 Byte Positions Between Navigation Message and Data Array

Navigation Message		Data Array		Navigation Message		Data Array	
Word	Byte	Word	Byte	Word	Byte	Word	Byte
3	MSB	[0]	LSB	7	MSB	[6]	MSB
3	Middle	[0]	MSB	7	Middle	[6]	LSB
3	LSB	[1]	LSB	7	LSB	[7]	MSB
4	MSB	[1]	MSB	8	MSB	[7]	LSB
4	Middle	[2]	LSB	8	Middle	[8]	MSB
4	LSB	[2]	MSB	8	LSB	[8]	LSB
5	MSB	[3]	LSB	9	MSB	[9]	MSB
5	Middle	[3]	MSB	9	Middle	[9]	LSB
5	LSB	[4]	LSB	9	LSB	[10]	MSB
6	MSB	[4]	MSB	10	MSB	[10]	LSB
6	Middle	[5]	LSB	10	Middle	[11]	MSB
6	LSB	[5]	MSB	10	LSB	[11]	LSB

Note – Message ID 130 uses a similar format but sends an array of 14 16-bit words for each SV and a total of 32 SVs in the message (almanac for SVs 1..32, in ascending order). For that message, a total of 448 words constitutes the data area. For each of 32 SVs, that corresponds to 14 words per SV. Those 14 words consist of one word containing the week number and status bit (described in Table 3-48 above as Almanac Week & Status), 12 words of the same data as described for the data area above, then a single 16-bit checksum of the previous 13 words. The SV PRN code is not included in the message 130 since the SV ID is inferred from the location in the array.

Ephemeris Data (Response to Poll) – Message ID 15

The ephemeris data that is polled from the receiver is in a special SiRF format based on the ICD-GPS-200 format for ephemeris data.

Output Rate: Response to poll

Table 3-50 Contents of Message ID 14

Name	Bytes	Description
Message ID	1	Hex 0x0E (decimal 14)
SV ID	1	SV PRN code, hex 0x01..0x02, decimal 1..32
Data[1]	90	**UINT16** [3][15] array with sub-frames 1..3 data.

Payload length: 92 bytes

1. The data area consists of a 3x15 array of unsigned integers, 16 bits long. The first word of each row in the array ([0][0], [1][0], and [2][0]) contain the SV ID. The remaining words in the row contain the data from the navigation message sub-frame, with row [0] containing sub-frame 1, row [1] containing sub-frame 2, and row [2] containing sub-frame 3. Data from the sub-frame is stored in a packed format, meaning that the 6 parity bits of each 30-bit navigation message word have been removed, and the remaining 3 bytes are stored in 1.5 16-bit words. Since the first word of the sub-frame, the telemetry word (TLM), does not contain any data needed by the receiver, it is not saved. Thus, there are 9 remaining words, with 3 bytes in each sub-frame. This total of 27 bytes is stored in 14 16-bit words. The second word of the sub-frame, the handover word (HOW), has its high byte (MSB) stored as the low byte (LSB) of the first of the 16-bit words. Each following byte is stored in the next available byte of the array. Table 3-51 shows where each byte of the sub-frame is stored in the row of 16-bit words.

Table 3-51 Byte Positions Between Navigation Message and Data Array

Navigation Message		Data Array		Navigation Message		Data Array	
Word	**Byte**	**Word**	**Byte**	**Word**	**Byte**	**Word**	**Byte**
2 (HOW)	MSB	[][1]	LSB	7	MSB	[][9]	MSB
2	Middle	[][2]	MSB	7	Middle	[][9]	LSB
2	LSB	[][2]	LSB	7	LSB	[][10]	MSB
3	MSB	[][3]	MSB	8	MSB	[][10]	LSB
3	Middle	[][3]	LSB	8	Middle	[][11]	MSB
3	LSB	[][4]	MSB	8	LSB	[][11]	LSB
4	MSB	[][4]	LSB	9	MSB	[][12]	MSB
4	Middle	[][5]	MSB	9	Middle	[][12]	LSB
4	LSB	[][5]	LSB	9	LSB	[][13]	MSB
5	MSB	[][6]	MSB	10	MSB	[][13]	LSB
5	Middle	[][6]	LSB	10	Middle	[][14]	MSB
5	LSB	[][7]	MSB	10	LSB	[][14]	LSB
6	MSB	[][7]	LSB				
6	Middle	[][8]	MSB				
6	LSB	[][8]	LSB				

Note – Message ID 149 uses the same format, except the SV ID (the second byte in Message ID 15) is omitted. Message ID 149 is thus a 91-byte message. The SV ID is still embedded in elements [0][0], [1][0], and [2][0] of the data array.

Test Mode 1 - Message ID 16

Output Rate: Variable - set by the period as specified in message ID 150

Example:

A0A20011—Start Sequence and Payload Length

100015001E000588B800C81B5800040001—Payload

02D8B0B3—Message Checksum and End Sequence

Table 3-52 Test Mode 1 Data - Message ID 16

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		10			16
SV ID	2		0015			21
Period	2		001E	sec		30
Bit Sync Time	2		0005	sec		5
Bit Count	2		88B8			35000
Poor Status	2		00C8			200
Good Status	2		1B58			7000
Parity Error Count	2		0004			4
Lost VCO Count	2		0001			1

Payload length: 17 bytes

Table 3-53 Detailed Description of Test Mode 1 Data

Name	Description
Message ID	Message ID number.
SV ID	The number of the satellite being tracked.
Period	The total duration of time (in seconds) that the satellite is tracked.
Bit Sync Time	The time it takes for channel 0 to achieve the status of 37.
Bit Count	The total number of data bits that the receiver is able to demodulate during the test period. As an example, for a 20 second test period, the total number of bits that can be demodulated by the receiver is 12000 (50BPS x 20sec x 12 channels).
Poor Status	This value is derived from phase accumulation time. Phase accumulation is the amount of time a receiver maintains phase lock. Every 100 msec of loss of phase lock equates to 1 poor status count. As an example, the total number of status counts for a 60 second period is 7200 (12 channels x 60 sec x 10 / sec).
Good Status	This value is derived from phase accumulation time. Phase accumulation is the amount of time a receiver maintains phase lock. Every 100 msec of phase lock equates to 1 good status count.
Parity Error Count	The number of word parity errors. This occurs when the parity of the transmitted word does not match the receiver’s computed parity.
Lost VCO Count	The number of 1 msec VCO lost lock was detected. This occurs when the PLL in the RFIC loses lock. A significant jump in crystal frequency and/or phase causes a VCO lost lock.

Differential Corrections - Message ID 17

Message ID 17 provides the RTCM data received from a DGPS source. The data is sent as a SiRF Binary message and is based on the RTCM SC-104 format. To interpret the data, see *RTCM Recommended Standards for Differential GNSS* by the Radio Technical Commission for Maritime Services. Data length and message output rate will vary based on received data.

Table 3-54 RTCM message

Name	Bytes	Example (Hex)	Example (Decimal)
Message ID	1	11	17
Data length	2	002D	45
Data[1]	variable		

Payload length: variable

1. Data length and message output rate will vary based on received data.

OkToSend - Message ID 18

Output Rate: Two messages per power-saving cycle

Example:

A0A20002—Start Sequence and Payload Length

1200—Payload

0012B0B3—Message Checksum and End Sequence

Table 3-55 Almanac Data - Message ID 18

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		12			18
Send Indicator[1]	1		00			00

Payload length: 2 bytes

1. 0 implies that CPU is about to go OFF, OkToSend==NO, 1 implies CPU has just come ON, OkToSend==YES

Note – This message is sent when the receiver is in a power saving mode. One message is sent just before the receiver's power is turned off (with Send Indicator set to 0), and one is sent once the power has been restored (with Send Indicator set to 1).

Navigation Parameters (Response to Poll) - Message ID 19

Output Rate: Response to Poll (See Message ID 152)

Example:

A0 A2 00 41 —Start Sequence and Payload Length

13 00 00 00 00 00 00 00 00 01 1E 0F 01 00 01 00 00 00 00 04 00 4B 1C 00 00 00 00 02 00 1E 00 00 00 00 00 00 00 03 E8 00 00 03 E8 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00—Payload

02 A4 B0 B3—Message Checksum and End Sequence

Table 3-56 Navigation Parameters - Message ID 19

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		13			19
Sub ID[1]	1		00			
Reserved	3		00			
Altitude Hold Mode[2]	1		00			
Altitude Hold Source[2]	1		00			
Altitude Source Input[2]	2		0000	m		
Degraded Mode[2]	1		00			
Degraded Timeout[2]	1		00	sec		
DR Timeout[2]	1		01	sec		
Track Smooth Mode[2]	1		1E			
Static Navigation[3]	1		0F			
3SV Least Squares[4]	1		01			
Reserved	4		00000000			
DOP Mask Mode[5]	1		04			
Navigation Elevation Mask[6]	2		004B			
Navigation Power Mask[7]	1		1C			
Reserved	4		00000000			
DGPS Source[8]	1		02			
DGPS Mode[9]	1		00			
DGPS Timeout[9]	1		1E	sec		
Reserved	4		00000000			
LP Push-to-Fix[10]	1		00			
LP On-time[10]	4		000003E8			
LP Interval[10]	4		000003E8			
User Tasks Enabled[4]	1		00			
User Task Interval[4]	4		00000000			
LP Power Cycling Enabled[11]	1		00			
LP Max. Acq. Search Time[12]	4		00000000	sec		
LP Max. Off Time[12]	4		00000000	sec		
APM Enabled/Power Duty Cycle[13,14]	1		00			
Number of Fixes[14]	2		0000			

Table 3-56 Navigation Parameters - Message ID 19 *(Continued)*

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Time Between Fixes[14]	2		0000	sec		
Horizontal/Vertical Error Max[15]	1		00	m		
Response Time Max[14]	1		00	sec		
Time/Accu & Time/Duty Cycle Priority[16]	1		00			

Payload length: 65 bytes

1. 00 = GSW2 definition; 01 = SiRF Binary APM definition; other values reserved.
2. These values are set by message ID 136. See description of values in Table 2-18.
3. These values are set by message ID 143. See description of values in Table 2-27.
4. These parameters are set in the software and are not modifiable via the User Interface.
5. These values are set by message ID 137. See description of values in Table 2-21.
6. These values are set by message ID 139. See description of values in Table 2-25.
7. These values are set by message ID 140. See description of values in Table 2-26.
8. These values are set by message ID 133. See description of values in Table 2-14.
9. These values are set by message ID 138. See description of values in Table 2-23.
10. These values are set by message ID 151. See description of values in Table 2-35.
11. This setting is derived from the LP on-time and LP interval.
12. These values are set by message ID 167. See description of values in Table 2-41.
13. Bit 7: APM Enabled, 1=enabled, 0=disabled; Bits 0-4: Power Duty Cycle, range: 1-20 scaled to 5%, 1=5%, 2=10%...
14. Only used in SiRFLoc software.
15. These values are set by message ID 53. See description of values in Table 2-4
16. Bits 2-3: Time Accuracy, 0x00=no priority imposed, 0x01=RESP_TIME_MAX has higher priority, 0x02=HORI_ERR_MAX has higher priority, Bits 0-1: Time Duty Cycle, 0x00=no priority imposed, 0x01=time between two consecutive fixes has priority, 0x02=power duty cycle has higher priority.

Table 3-57 Horizontal/Vertical Error

Value	Position Error
0x00	< 1 meter
0x01	< 5 meter
0x02	< 10 meter
0x03	< 20 meter
0x04	< 40 meter
0x05	< 80 meter
0x06	< 160 meter
0x07	No Maximum (disabled)
0x08 - 0xFF	Reserved

Test Mode 2/3/4 - Message ID 20, 46, 48 (SiRFLoc v2.x), 49, and 55

Table 3-58 describes the SiRF software and test mode 2/3/4 with respect to their respective message ID.

Table 3-58 SiRF Software and Test Mode in relation with Message ID 20, 46, 48, 49, and 55

Software	Test Mode	Message ID
GSW2	2	20
	3/4	46
SiRFDRive	2	20
	3/4	46
SiRFXTrac	2/3/4	20
SiRFLoc (version 2.x)	4	20, 48[1], and 49
SiRFLoc (version 3.x)	3	46
	4	46, 55
GSW3, GSWLT3	3	46
	4	46, 55

1. This message ID 48 for Test Mode 4 is not to be confused with message ID 48 for DR Navigation. Message ID 48 for SiRFLoc will be transferred to a different message ID in a near future.

Refer to each specific message ID for more details.

Test Mode 2/3/4 - Message ID 20

Test Mode 2

This is supported by either GSW2, SiRFDRive, and SiRFXTrac. Test Mode 2 requires approximately 1.5 minutes of data collection before sufficient data is available.

The definition of MID 20 is different depending on the version and type of software being used.

Example:

A0A20033—Start Sequence and Payload Length

140001001E00023F70001F0D2900000000000601C600051B0E000EB41A000000000000000000000000000000000000000000000000000000000000—Payload

0316B0B3—Message Checksum and End Sequence

Table 3-59 Test Mode 2 - Message ID 20

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		14			20
SV ID	2		0001			1
Period	2		001E	sec		30
Bit Sync Time	2		0002	sec		2
Bit Count	2		3F70			13680

Table 3-59 Test Mode 2 - Message *(Continued)*ID 20 *(Continued)*

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Poor Status	2		001F			31
Good Status	2		0D29			3369
Parity Error Count	2		0000			0
Lost VCO Count	2		0000			0
Frame Sync Time	2		0006	sec		6
C/No Mean	2	*10	01C6		÷10	45.4
C/No Sigma	2	*10	0005		÷10	0.5
Clock Drift Change	2	*10	1B0E	Hz	÷10	692.6
Clock Drift	4	*10	000EB41A	Hz	÷10	96361.0
Reserved	2		0000			
Reserved	4		00000000			
Reserved	4		00000000			
Reserved	4		00000000			
Reserved	4		00000000			
Reserved	4		00000000			

Payload length: 51 bytes

Table 3-60 Detailed Description of Test Mode 2 Message ID 20

Name	Description
Message ID	Message ID number.
SV ID	The number of the satellite being tracked.
Period	The total duration of time (in seconds) that the satellite is tracked.
Bit Sync Time	The time it takes for channel 0 to achieve the status of 37.
Bit Count	The total number of data bits that the receiver is able to demodulate during the test period. As an example, for a 20 second test period, the total number of bits that can be demodulated by the receiver is 12000 (50 bps x 20 sec x 12 channels).
Poor Status	This value is derived from phase accumulation time. Phase accumulation is the amount of time a receiver maintains phase lock. Every 100 msec of loss of phase lock equates to 1 poor status count. As an example, the total number of status counts for a 60 second period is 7200 (12 channels x 60 sec x 10 sec)
Good Status	This value is derived from phase accumulation time. Phase accumulation is the amount of time a receiver maintains phase lock. Every 100 msec of phase lock equates to 1 good status count.
Parity Error Count	The number of word parity errors. This occurs when the transmitted parity word does not match the receivers parity check.
Lost VCO Count	The number of 1 msec VCO lost lock was detected. This occurs when the PLL in the RFIC loses lock. A significant jump in crystal frequency and / or phase will cause a VCO lost lock.
Frame Sync	The time it takes for channel 0 to reach a 3F status.
C/No Mean	Calculated average of reported C/No by all 12 channels during the test period.
C/No Sigma	Calculated sigma of reported C/No by all 12 channels during the test period.
Clock Drift Change	Difference in clock frequency from start and end of the test period.
Clock Drift	Rate of change in clock bias.

Test Mode 3

This is supported by SiRFXTrac only as MID 20. Test Mode 3 requires approximately 10 seconds of data collection before sufficient data is available.

Example:

A0A20033—Start Sequence and Payload Length

140001001E00023F70001F0D2900000000000601C600051B0E000EB41A000000000000000000000000000000000000000000000000000000000000—Payload

0316B0B3—Message Checksum and End Sequence

Table 3-61 Test Mode 3 - Message ID 20

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		14			20
SV ID	2		0001			1
Period	2		001E	sec		30
Bit Sync Time	2		0002	sec		2
Bit Count	2		3F70			13680
Poor Status	2		001F			31
Good Status	2		0D29			3369
Parity Error Count	2		0000			0
Lost VCO Count	2		0000			0
Frame Sync Time	2		0006	sec		6
C/No Mean	2	*10	01C6		÷10	45.4
C/No Sigma	2	*10	0005		÷10	0.5
Clock Drift Change	2	*10	1B0E	Hz	÷10	692.6
Clock Drift	4	*10	000EB41A	Hz	÷10	96361.0
Bad 1Khz Bit Count	2		0000			
Abs I20ms	4		00000000			
Abs Q1ms	4		00000000			
Reserved	4		00000000			
Reserved	4		00000000			
Reserved	4		00000000			

Payload length: 51 bytes

Table 3-62 Detailed Description of Test Mode 3 Message ID 20

Name	Description
Message ID	Message ID number.
SV ID	The number of the satellite being tracked.
Period	The total duration of time (in seconds) that the satellite is tracked.
Bit Sync Time	The time it takes for channel 0 to achieve the status of 37.
Bit Count	The total number of data bits that the receiver is able to demodulate during the test period. As an example, for a 20 second test period, the total number of bits that can be demodulated by the receiver is 12000 (50 bps x 20sec x 12 channels).

Table 3-62 Detailed Description of Test Mode 3 Message ID 20

Name	Description
Poor Status	This value is derived from phase accumulation time. Phase accumulation is the amount of time a receiver maintains phase lock. Every 100 msec of loss of phase lock equates to 1 poor status count. As an example, the total number of status counts for a 60 second period is 7200 (12 channels x 60 sec x 10 sec)
Good Status	This value is derived from phase accumulation time. Phase accumulation is the amount of time a receiver maintains phase lock. Every 100 msec of phase lock equates to 1 good status count.
Parity Error Count	The number of word parity errors. This occurs when the transmitted parity word does not match the receivers parity check.
Lost VCO Count	The number of 1 msec VCO lost lock was detected. This occurs when the PLL in the RFIC loses lock. A significant jump in crystal frequency and / or phase will cause a VCO lost lock.
Frame Sync	The time it takes for channel 0 to reach a 3F status.
C/No Mean	Calculated average of reported C/No by all 12 channels during the test period.
C/No Sigma	Calculated sigma of reported C/No by all 12 channels during the test period.
Clock Drift Change	Difference in clock frequency from start and end of the test period.
Clock Drift	Rate of change of clock bias.
Bad 1Khz Bit Count	Errors in 1 ms post correlation I count values.
Abs I20ms	Absolute value of the 20 ms coherent sums of the I count over the duration of the test period.
Abs Q1ms	Absolute value of the 1 ms Q count over the duration of the test period.

Test Mode 4

This is supported by SiRFXTrac only.

Table 3-63 Test Mode 4 - Message ID 20

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		14			20
Test Mode	1		04			4
Message Variant	1		01			1
SV ID	2		0001			1
Period	2		001E	sec		30
Bit Sync Time	2		0002	sec		2
C/No Mean	2	*10	01C6		÷10	45.4
C/No Sigma	2	*10	0005		÷10	0.5
Clock Drift Change	2	*10	1B0E	Hz	÷10	692.6
Clock Drift	4	*10	000EB41A	Hz	÷10	96361.0
I Count Errors	2		0003			3
Abs I20ms	4		0003AB88			240520
Abs Q1ms	4		0000AFF0			45040
Payload length: 29 bytes						

Table 3-64 Detailed Description of Test Mode 4 Message ID 20

Name	Description
Message ID	Message ID number.
Test Mode	3=Testmode 3, 4=Testmode 4
Message Variant	The variant # of the message (variant change indicates possible change in number of fields or field description).
SV ID	The number of the satellite being tracked.
Period	The total duration of time (in seconds) that the satellite is tracked.
Bit Sync Time	The time it takes for channel 0 to achieve the status of 37.
C/No Mean	Calculated average of reported C/No by all 12 channels during the test period.
C/No Sigma	Calculated sigma of reported C/No by all 12 channels during the test period.
Clock Drift	Difference in clock frequency from start and end of the test period.
Clock Offset	The internal clock offset.
I Count Errors	Errors in 1 ms post correlation I count values.
Abs I20ms	Absolute value of the 20 ms coherent sums of the I count over the duration of the test period.
Q 1ms	Absolute value of the 1 ms Q count over the duration of the test period.

DGPS Status - Format - Message ID 27

This message reports on the current DGPS status, including the source of the corrections and which satellites have corrections available.

Output Rate: Every measurement cycle (full power / continuous: 1 Hz)

Example (with SBAS):

A0A20034—Start Sequence and Payload Length

1B144444444407252864A2EC .... —Payload

1533B0B3—Message Checksum and End Sequence

The above example looks as follows in ASCII format:

27, 1, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 0, 0, 7, 594, 8, 100, 10, 748

Table 3-65 DGPS Status - Format - Message ID 27

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message I.D.	1		1B			27
DGPS source[1]	1		1			1 = SBAS
If the DGPS source is Beacon, next 14 bytes are interpreted as follows:						
Beacon Frequency	4	100	0 - 0xFFF 0=190K, 0xFFF=599.5K Frequency= (190000)+(100*value)	Hz		

Table 3-65 DGPS Status - Format - Message ID 27 *(Continued)*

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Beacon Bit Rate	1		Bits 2 - 0 : 000 25 bits/sec 001 50 bits/sec 010 100 bits/sec 011 110 bits/sec 100 150 bits/sec 101 200 bits/sec 110 250 bits/sec 111 300 bits/sec Bit 4 : modulation (0=MSK, 1=FSK) Bit 5 : SYNC type (0=async, 1=sync) Bit 6 : broadcast coding (0=No Coding, 1=FEC coding)	BPS		
Status	1		Bitmapped 0x01: signal valid 0x02: auto frequency used 0x04: auto bit rate used			Bitmapped 0x
Signal Magnitude	4			internal counts		
Signal Strength	2			dB		
SNR	2			dB		
If the DGPS source is not Beacon, next 14 bytes are interpreted as follows:						
Correction Age[2] [12]	1 x 12		4	seconds		4
Reserved	2					
Remainder of the table applies to all messages, and reports on available corrections						
Satellite PRN Code	1		18			SV = 24
DGPS Correction	2		24E	meters	100	5.90
The above 3 bytes are repeated a total of 12 times. If less than 12 satellite corrections are available, the unused entries will have values of 0.						

Payload length: 52 bytes

1. Possible values for this field are given in Table 3-66. If the GSPS source is set to none, three messages are being sent and then the message is disabled.
2. Correction age is reported in the same order as satellites are listed in the satellite PRN code fields that follow.

Table 3-66 DGPS Correction Types

DGPS Correction Types	Value	Description
None	0	No DGPS correction type have been selected
SBAS	1	SBAS
Serial Port	2	RTCM corrections
Internal Beacon	3	Beacon corrections (available only for GSW2 software)
Software	4	Software Application Program Interface (API) corrections

Note – This message differs from others in that it has multiple formats. Further, not all SiRF software versions implement all of the features. All versions implement the first 2 bytes and the last 3 x 12 bytes (3 bytes per satellite times 12 satellites) the same. The 14 bytes in between these two sections vary depending on the source of the DGPS information. If the source is an internal beacon, the 14 bytes are used to display information about the beacon itself (frequency, bit rate, etc.). If the source is something other than an internal beacon, some software versions display the age of the corrections while other versions only fill this area with zeroes.

Navigation Library Measurement Data - Message ID 28

Output Rate: Every measurement cycle (full power / continuous: 1 Hz)

Example:

A0A20038—Start Sequence and Payload Length

1C00000660D015F143F62C4113F42F417B235CF3FBE95E468C6964B8FBC582415CF1C375301734.....03E801F400000000—Payload

1533B0B3—Message Checksum and End Sequence

Table 3-67 Navigation Library Measurement Data - Message ID 28

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		1C			28
Channel	1		00			0
Time Tag[1]	4		000660D0	ms		135000
Satellite ID	1		15			20
GPS Software Time[2]	8		41740B0B48353F7D	sec		2.4921113696e+005
Pseudorange[3]	8		7D3F354A0B0B7441	m		2.1016756638e+007
Carrier Frequency	4		89E98246	m/s		1.6756767578e+004
Carrier Phase[4]	8		A4703D4A0B0B7441	m		2.1016756640e+007
Time in Track	2		7530	ms		10600
Sync Flags	1		17			23
C/No 1	1		34	dB-Hz		43
C/No 2	1			dB-Hz		43
C/No 3	1			dB-Hz		43
C/No 4	1			dB-Hz		43
C/No 5	1			dB-Hz		43
C/No 6	1			dB-Hz		43
C/No 7	1			dB-Hz		43
C/No 8	1			dB-Hz		43
C/No 9	1			dB-Hz		43
C/No 10	1			dB-Hz		43
Delta Range Interval	2		03E801F4	ms		1000
Mean Delta Range Time	2		01F4	ms		500

Table 3-67 Navigation Library Measurement Data - Message ID 28 *(Continued)*

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Extrapolation Time[5]	2		0000	ms		
Phase Error Count	1		00			0
Low Power Count	1		00			0

Payload length: 56 bytes

1. Internal time for relative measure only.
2. GPS software time minus clock bias = GPS time of measurement.
3. Does not include iono delay.
4. GSW3 and GSWLT3 software does not report the Carrier Phase.
5. Reserved for SiRF use with GSW3, GSWLT3, GSW2.0 or above.

Note – For GPS Software Time, Pseudorange, Carrier Frequency, and Carrier Phase, the fields are floating point (4-byte fields) or double-precision floating point (8-byte fields), per IEEE-754 format. The byte order may have to be changed to be properly interpreted on some computers. Also, GSW3.x and GSWLT3 use the same byte ordering method as the GSW 2.2.0. Therefore, GSW 2.2.0 (and older) and GSW 3.0 (and newer) use the original byte ordering method; GSW 2.3.0 through 2.9.9 use an alternate byte ordering method.

To convert the data to be properly interpreted on a PC-compatible computer, do the following: For double-precision (8-byte) values: Assume the bytes are transmitted in the order of B0, B1, ... , B7. For version 2.2.0 and earlier software, rearrange them to B3, B2, B1, B0, B7, B6, B5, B4. For version 2.3.0 and later software, rearrange them to B7, B6, B5, ... , B0. For single-precision (4-byte) values: Assume bytes are transmitted in the order of B0, B1, B2, B.3 Rearrange them to B3, B2, B1, B0 (that is, byte B3 goes into the lowest memory address, B0 into the highest).

With these remappings, the values should be correct. To verify, compare the same field from several satellites tracked at the same time. The reported exponent should be similar (within 1 power of 10) among all satellites. The reported Time of Measurement, Pseudorange and Carrier Phase are all uncorrected values.

Message ID 7 contains the clock bias which must be considered. Adjust the GPS Software time by subtracting clock bias, adjust pseudorange by subtracting clock bias times the speed of light, and adjust carrier phase by subtracting clock bias times speed of light/GPS L1 frequency. To adjust the reported carrier frequency do the following: Corrected Carrier Frequency (m/s) = Reported Carrier Frequency (m/s) - Clock Drift (Hz)*C / 1575420000 Hz. For a nominal clock drift value of 96.25 kHz (equal to a GPS Clock frequency of 24.5535 MHz), the correction value is 18315.766 m/s.

Note – GPS Software Time - Clock Bias = Time of Receipt = GPS Time. GPS Software Time - Pseudorange (sec) = Time of Transmission = GPS Time. Be sure to adjust SV position in MID 30 by (GPS Time $_{\text{MID 30}}$ - Time of Transmission) * V_{sat}.

Table 3-68 Sync Flag Fields

Bit Fields	Description
[0]	Coherent Integration Time 0 = 2 ms 1 = 10 ms
[2:1]	Synch State 00 = Not aligned 01 = Consistent code epoch alignment 10 = Consistent data bit alignment 11 = No millisecond errors
[4:3]	Autocorrelation Detection State 00 = Verified not an autocorrelation 01 = Testing in progress 10 = Strong signal, autocorrelation detection not run 11 = Not used

Table 3-69 Detailed Description of the Measurement Data

Name	Description
Message ID	Message ID number.
Channel	Receiver channel number for a given satellite being searched or tracked. Range of 0-11 for channels 1-12, respectively.
Time Tag	This is the Time Tag in milliseconds of the measurement block in the receiver software time. Time tag is an internal millisecond counter which has no direct relationship to GPS time, but is started as the receiver is turned on or reset.
Satellite ID	Pseudo-Random Noise (PRN) number.
GPS Software Time	This is GPS Time of Week (TOW) estimated by the software in milliseconds.
Pseudorange	This is the generated pseudorange measurement for a particular SV. When carrier phase is locked, this data is smoothed by carrier phase.
Carrier Frequency	This can be interpreted in two ways: 1. The delta pseudorange normalized by the reciprocal of the delta pseudorange measurement interval. 2. The frequency from the AFC loop. If, for example, the delta pseudorange interval computation for a particular channel is zero, it can be the AFC measurement, otherwise it is a delta pseudorange computation.[1]
Carrier Phase	For GSW2 software, the integrated carrier phase (meters), which initially is made equal to pseudorange, is integrated as long as carrier lock is retained. Discontinuity in this value generally means a cycle slip and renormalization to pseudorange. For GSW3 and GSWLT3 software, this field duplicates the state field seen in MID 4. See Table 3-9.
Time in Track	The Time in Track counts how long a particular SV has been in track. For any count greater than zero (0), a generated pseudorange is present for a particular channel. The length of time in track is a measure of how large the pull-in error may be.

Table 3-69 Detailed Description of the Measurement Data *(Continued)*

Name	Description
Sync Flags	For GSW2, this byte contains two 2-bit fields and one 1-bit field that describe the Autocorrelation Detection State, Synch State and Coherent Integration Time. Refer to Table 3-68 for more details. For GSW3, this field contains a duplicate of the state field of MID 4. See Table 3-9 for details.
C/No 1	This array of Carrier To Noise Ratios is the average signal power in dB-Hz for each of the 100-millisecond intervals in the previous second or last epoch for each particular SV being track in a channel. First 100 millisecond measurement
C/No 2	Second 100 millisecond measurement
C/No 3	Third 100 millisecond measurement
C/No 4	Fourth 100 millisecond measurement
C/No 5	Fifth 100 millisecond measurement
C/No 6	Sixth 100 millisecond measurement
C/No 7	Seventh 100 millisecond measurement
C/No 8	Eighth 100 millisecond measurement
C/No 9	Ninth 100 millisecond measurement
C/No 10	Tenth 100 millisecond measurement
Delta Range Interval	This is the delta-pseudorange measurement interval for the preceding second. A value of zero indicated that the receiver has an AFC measurement or no measurement in the Carrier Frequency field for a particular channel.
Mean Delta Range Time	This is the mean calculated time of the delta-pseudorange interval in milliseconds measured from the end of the interval backwards
Extrapolation Time	In GSW2, this is the pseudorange extrapolation time, in milliseconds, to reach the common Time tag value. Reserved for SiRF use in GSW3 and GSWLT3.
Phase Error Count	This is the count of the phase errors greater than 60 degrees measured in the preceding second as defined for a particular channel.
Low Power Count	This is the low power measurements for signals less than 28 dB-Hz in the preceding second as defined for a particular channel. Similar for GSW3 and GSWLT3 but does not use 28 dB-Hz; it uses a filter with time constant (t) that equals approximately 1 second.

1. Carrier frequency may be interpreted as the measured Doppler on the received signal. The value is reported in metres per second but can be converted to hertz using the Doppler equation:

   Doppler frequency / Carrier frequency = Velocity / Speed of light, where Doppler frequency is in Hz; Carrier frequency = 1,575,420,000 Hz; Velocity is in m/s; Speed of light = 299,792,458 m/s.

   Note that the computed Doppler frequency will contain a bias equal to the current clock drift as reported in message ID 7. This bias, nominally 96.250 kHz, is equivalent to over 18 km/s.

Navigation Library DGPS Data - Message ID 29

Output Rate: Every measurement cycle (full power / continuous: 1 Hz)

Example:

A0A2001A—Start Sequence and Payload Length

1D000F00B501BFC97C673CAAAAAB3FBFFE1240A0000040A00000—Payload

0956B0B3—Message Checksum and End Sequence

Table 3-70 Navigation Library DGPS Data - Message ID 29

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		1D			29
Satellite ID	2		000F			15
IOD	2		00B5			181
Source[1]	1		01			1
Pseudorange Correction	4		BFC97C67	m		-1.574109
Pseudorange rate Correction	4		3CAAAAAB	m/sec		0.020833
Correction Age	4		3FBFFE12	sec		1.499941
Reserved	4					
Reserved	4					

Payload length: 26 bytes

1. 0 = Use no corrections, 1 = SBAS channel, 2 = External source, 3 = Internal Beacon, 4 = Set Corrections via software

Note – The fields Pseudorange Correction, Pseudorange Rate Correction, and Correction Age are floating point values per IEEE-754. To properly interpret these in a computer, the bytes must be rearranged into reverse order.

Navigation Library SV State Data - Message ID 30

The data in Message ID 30 reports the computed satellite position and velocity at the specified GPS time.

Note – When using MID 30 SV position, adjust for difference between GPS Time $_{\text{MID 30}}$ and Time of Transmission (see note in Message ID 28). Iono delay is not included in pseudorange in MID 28.

Output Rate: Every measurement cycle (full power / continuous: 1 Hz)

Example:

A0A20053—Start Sequence and Payload Length

1E15....2C64E99D01....408906C8—Payload

2360B0B3—Message Checksum and End Sequence

Table 3-71 Navigation Library SV State Data - Message ID 30

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		1E			30
Satellite ID	1		15			21
GPS Time	8			sec		
Position X	8			m		
Position Y	8			m		
Position Z	8			m		

Table 3-71 Navigation Library SV State Data - Message ID 30 *(Continued)*

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Velocity X	8			m/sec		
Velocity Y	8			m/sec		
Velocity Z	8			m/sec		
Clock Bias	8			sec		
Clock Drift	4		2C64E99D	s/s		744810909
Ephemeris Flag (see details in Table 3-72)	1		01			1
Reserved	4					
Reserved	4					
Ionospheric Delay	4		408906C8	m		1082721992

Payload length: 83 bytes

Note – Each of the 8-byte fields as well as Clock Drift and Ionospheric Delay fields are floating point values per IEEE-754. To properly interpret these in a computer, the bytes must be rearranged. See Note in “Navigation Library Measurement Data - Message ID 28” on page 34 for byte orders.

Table 3-72 Ephemeris Flag Definition

Ephemeris Flag Value	Definition
0x00	No Valid SV state
0x01	SV state calculated from broadcast ephemeris
0x02	SV state calculated from almanac at least 0.5 week old
0x03	Assist data used to calculate SV state
0x04	SV state calculated from almanac less than 0.5 weeks old
0x11	SV state calculated from extended ephemeris with age of 1 day
0x12	SV state calculated from extended ephemeris with age of 2 days
0x13	SV state calculated from extended ephemeris with age of 3 days
0x14	SV state calculated from extended ephemeris with age of 4 days
0x15	SV state calculated from extended ephemeris with age of 5 days
0x16	SV state calculated from extended ephemeris with age of 6 days
0x17	SV state calculated from extended ephemeris with age of 7 days

Navigation Library Initialization Data - Message ID 31

Output Rate: Every measurement cycle (full power / continuous: 1 Hz)

Example:

A0A20054—Start Sequence and Payload Length

1F....00000000000001001E000F....00....000000000F....00....02....043402....

....02—Payload

0E27B0B3—Message Checksum and End Sequence

Table 3-73 Navigation Library Initialization Data - Message ID 31

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		1F			31
Reserved	1					
Altitude Mode[1]	1		00			0
Altitude Source	1		00			0
Altitude	4		00000000	m		0
Degraded Mode[2]	1		01			1
Degraded Timeout	2		001E	sec		30
Dead-reckoning Timeout	2		000F	sec		15
Reserved	2					
Track Smoothing Mode[3]	1		00			0
Reserved	1					
Reserved	2					
Reserved	2					
Reserved	2					
DGPS Selection[4]	1		00			0
DGPS Timeout	2		0000	sec		0
Elevation Nav. Mask	2	2	000F	deg		15
Reserved	2					
Reserved	1					
Reserved	2					
Reserved	1					
Reserved	2					
Static Nav. Mode[5]	1		00			0
Reserved	2					
Position X	8			m		
Position Y	8			m		
Position Z	8			m		
Position Init. Source[6]	1		02			2
GPS Time	8			sec		
GPS Week	2		0434			1076
Time Init. Source[7]	1		02	sec		2
Drift	8			Hz		
Drift Init. Source[8]	1		02	sec		2

Payload length: 84 bytes

1. 0 = Use last know altitude, 1 = Use user input altitude, 2 = Use dynamic input from external source
2. 0 = Use direction hold and then time hold, 1 = Use time hold and then direction hold, 2 = Only use direction hold, 3 = Only use time hold, 4 = Degraded mode is disabled
3. 0 = True, 1 = False
4. 0 = Use DGPS if available, 1 = Only navigate if DGPS corrections are available, 2 = Never use DGPS corrections
5. 0 = True, 1 = False
6. 0 = ROM position, 1 = User position, 2 = SRAM position, 3 = Network assisted position
7. 0 = ROM time, 1 = User time, 2 = SRAM time, 3 = RTC time, 4 = Network assisted time
8. 0 = ROM clock, 1 = User clock, 2 = SRAM clock, 3 = Calibration clock, 4 = Network assisted clock

Note – Altitude is a single-precision floating point value while position XYZ, GPS time, and drift are double-precision floating point values per IEEE-754. To properly interpret these values in a computer, the bytes must be rearranged. See Note in MID 28 for byte orders.

Geodetic Navigation Data - Message ID 41

Output Rate:Every measurement cycle (full power / continuous: 1 Hz)

Example:

A0 A2 00 5B—Start Sequence and Payload Length

29 00 00 02 04 04 E8 1D 97 A7 62 07 D4 02 06 11 36 61 DA 1A 80 01 58 16 47 03 DF B7 55 48 8F FF FF FA C8 00 00 04 C6 15 00 00 00 00 00 00 00 00 00 00 00 00 BB 00 00 01 38 00 00 00 00 00 00 6B 0A F8 61 00 00 00 00 00 1C 13 14 00 00 00 00 00 00 00 00 00 00 00 08 05 00—Payload

11 03 B0 B3—Message Checksum and End Sequence

Table 3-74 Geodetic Navigation Data

Name	Bytes	Description
Message ID	1	Hex 0x29 (decimal 41)
Nav Valid	2	0x0000 = valid navigation (any bit set implies navigation solution is not optimal); Bit 0 ON: solution not yet overdetermined[1] (< 5 SVs), OFF: solution overdetermined[1] (>= 5 SV) Bits 1 - 2 : Reserved Bits 8 - 14 : Reserved (The following are for SiRFDRive only) Bit 3 ON : invalid DR sensor data Bit 4 ON : invalid DR calibration Bit 5 ON : unavailable DR GPS-based calibration Bit 6 ON : invalid DR position fix Bit 7 ON : invalid heading (The following is for SiRFNav only) Bit 15 ON : no tracker data available

Table 3-74 Geodetic Navigation Data *(Continued)*

Name	Bytes	Description
NAV Type	2	Bits 2 - 0 : GPS position fix type 000 = no navigation fix 001 = 1-SV KF solution 010 = 2-SV KF solution 011 = 3-SV KF solution 100 = 4 or more SV KF solution 101 = 2-D least-squares solution 110 = 3-D least-squares solution 111 = DR solution (see bits 8, 14-15) Bit 3 : TricklePower in use Bits 5 - 4 : altitude hold status 00 = no altitude hold applied 01 = holding of altitude from KF 10 = holding of altitude from user input 11 = always hold altitude (from user input) Bit 6 ON : DOP limits exceeded Bit 7 ON : DGPS corrections applied Bit 8 : Sensor DR solution type (SiRFDRive only) 1 = sensor DR 0 = velocity DR[2] if Bits 0 - 2 = 111; else check Bits 14-15 for DR error status Bit 9 ON : navigation solution overdetermined[1] Bit 10 ON : velocity DR[2] timeout exceeded Bit 11 ON : fix has been edited by MI functions Bit 12 ON : invalid velocity Bit 13 ON : altitude hold disabled Bits 15 - 14 : sensor DR error status (SiRFDRive only) 00 = GPS-only navigation 01 = DR calibration from GPS 10 = DR sensor error 11 = DR in test
Extended Week Number	2	GPS week number; week 0 started January 6 1980. This value is extended beyond the 10-bit value reported by the SVs.
TOW	4	GPS time of week in seconds x 10^3.
UTC Year	2	UTC time and date. Seconds reported as integer milliseconds only.
UTC Month	1	
UTC Day	1	
UTC Hour	1	
UTC Minute	1	
UTC Second	2	
Satellite ID List	4	Bit map of SVs used in solution. Bit 0 = SV 1, Bit 31 = SV 32. A bit set ON means the corresponding SV was used in the solution.
Latitude	4	In degrees (+ = North) x 10^7.
Longitude	4	In degrees (+ = East) x 10^7.
Altitude from Ellipsoid	4	In meters x 10^2.
Altitude from MSL	4	In meters x 10^2.
Map Datum[3]	1	See footnote.
Speed Over Ground (SOG)	2	In m/s x 10^2.

Table 3-74 Geodetic Navigation Data *(Continued)*

Name	Bytes	Description
Course Over Ground (COG, True)	2	In degrees clockwise from true north x 10^2.
Magnetic Variation	2	Not implemented.
Climb Rate	2	In m/s x 10^2.
Heading Rate	2	deg/s x 10^2 (SiRFDRive only).
Estimated Horizontal Position Error	4	EHPE in meters x 10^2.
Estimated Vertical Position Error	4	EVPE in meters x 10^2.
Estimated Time Error	4	ETE in seconds x 10^2 (SiRFDRive only).
Estimated Horizontal Velocity Error	2	EHVE in m/s x 10^2 (SiRFDRive only).
Clock Bias[4]	4	In m x 10^2.
Clock Bias Error[4]	4	In meters x 10^2 (SiRFDRive only).
Clock Drift[4]	4	In m/s x 10^2.
Clock Drift Error[4]	4	In m/s x 10^2 (SiRFDRive only).
Distance	4	Distance traveled since reset in meters (SiRFDRive only).
Distance error	2	In meters (SiRFDRive only).
Heading Error	2	In degrees x 10^2 (SiRFDRive only).
Number of SVs in Fix	1	Count of SVs indicated by SV ID list.
HDOP	1	Horizontal Dilution of Precision x 5 (0.2 resolution).
AdditionalModeInfo	1	Additional mode information: Bit 0: map matching mode for Map Matching only 0 = map matching feedback input is disabled 1 = map matching feedback input is enabled Bit 1: map matching feedback received for Map Matching only 0 = map matching feedback was not received 1 = map matching feedback was received Bit 2: map matching in use for Map Matching only 0 = map matching feedback was not used to calculate position 1 = map matching feedback was used to calculate position Bit 3-6: reserved Bit 7: DR direction for SiRFDRive only 0 = forward 1 = reserve

Payload length: 91 bytes

1. An overdetermined solution (see bit 0 from Nav Valid and bit 9 of Nav Type) is one where at least one additional satellite has been used to confirm the 4-satellite position solution. Once a solution has been overdetermined, it remains so even if several satellites are lost, until the system drops to no-navigation status (Nav Type bits 0-2 = 000).
2. Velocity Dead Reckoning (DR) is a method by which the last solution computed from satellite measurements is updated using the last computed velocity and time elapsed to project the position forward in time. It assumes heading and speed are unchanged, and is thus reliable for only a limited time. Sensor DR is a position update method based on external sensors (e.g., rate gyroscope, vehicle speed pulses, accelerometers) to supplement the GPS measurements. Sensor DR is only applicable to SiRF's SiRFDRive products.
3. Map Datum indicates the datum to which latitude, longitude, and altitude relate. 21 = WGS-84, by default. Other values will be defined as other datums are implemented. Available datums include: 21 = WGS-84, 178 = Tokyo Mean, 179 = Tokyo Japan, 180 = Tokyo Korea, 181 = Tokyo Okinawa.
4. To convert Drift m/s to Hz: Drift (m/s) *L1(Hz)/c = Drift (Hz).

Note – Values are transmitted as integer values. When scaling is indicated in the description, the decimal value has been multiplied by the indicated amount and then converted to an integer. Example: Value transmitted: 2345; indicated scaling: 10^2; actual value: 23.45.

Queue Command Parameters - Message ID 43

Output Rate: Response to poll

This message outputs Packet/Send command parameters under SiRF Binary Protocol.

Example with **MID_SET_STAT_NAV** message:

A0A20003—Start Sequence and Payload Length

438F00—Payload

00D2B0B3—Message Checksum and End Sequence

Table 3-75 Queue Command Parameters

Name	Bytes	Scale	Units	Description
MID	1			=0x2B
Polled Msg ID	1			=0x8F (example)
Data	Variable			Depends on the polled message ID length

Payload length: Variable length bytes (3 bytes in the example))

DR Raw Data - Message ID 45

Table 3-76 1-Hz DR Raw Data from ADC (Output After Collection of Data)

Name	Bytes	Scale	Units	Description
MID	1			=0x2D
1st 100-ms time-tag	4		ms	
1st 100-ms ADC2 average measurement	2			
Reserved	2			
1st 100-ms odometer count	2			
1st 100-ms GPIO input states	1			Bit 0: reverse
2nd 100-ms time-tag	4		ms	
2nd 100-ms ADC2 average measurement	2			
Reserved	2			
2nd 100-ms odometer count	2			
2nd 100-ms GPIO input states	1			Bit 0: reverse
...				
10th 100-ms time-tag	4		ms	
10th 100-ms ADC2 average measurement	2			
Reserved	2			
10th 100-ms odometer count	2			
10th 100-ms GPIO input states	1			Bit 0: reverse

Payload length: 111 bytes

Test Mode 3/4 - Message ID 46

Message ID 46 is used by GSW2, SiRFDRive, SiRFLoc v3.x, GSW3, GSWLT3, and SLCLT3 software.

Output Rate: Variable - set by the period as defined in message ID 150.

Example for GSW2, SiRFDRive, SiRFLoc v3.x, and GSW3 software output:

A0A20033—Start Sequence and Payload Length

2E0001001E00023F70001F0D2900000000000601C600051B0E000EB41A00000000000000000000000000000000000000000000000000—Payload

0316B0B3—Message Checksum and End Sequence

Example for GSWLT3 and SLCLT3 software output:

A0A20033—Start Sequence and Payload Length

2E0001001E00023F70001F0D2900000000000601C600051B0E000EB41A00000000000000000000000800000002F000000—Payload

0316B0B3—Message Checksum and End Sequence

Table 3-77 Test Mode 3/4 - Message ID 46

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		2E			46
SV ID	2		0001			1
Period	2		001E	sec		30
Bit Sync Time[1]	2		0002	sec		2
Bit Count[1]	2		3F70			16420
Poor Status[1]	2		001F			31
Good Status[1]	2		0D29			3369
Parity Error Count[1]	2		0000			0
Lost VCO Count[1]	2		0000			0
Frame Sync Time[1]	2		0006	sec		6
C/No Mean	2	*10	01C6	dB/Hz	÷10	45.4
C/No Sigma	2	*10	0005	dB/Hz	÷10	0.5
Δ Clock Drift	2	*10	1B0E	Hz	÷10	692.6
Clock Drift	4	*10	000EB41A	Hz	÷10	96361.0
Bad 1Khz Bit Count[1]	2		0000			0
Abs I20ms[2]	4		000202D5	Counts		131797
Abs Q1ms[2]	4		000049E1	Counts		18913
Phase Lock Indicator	4		00000000		0.001	0
RTC Frequency[3]	2		8000	Hz		32768
ECLK Ratio[3]	2		0000		3*Value/ 65535	0 (no ECLK input)

Table 3-77 Test Mode 3/4 - Message ID 46 *(Continued)*

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Timer Synch[3] (bit 7) AGC[3] (bit 0 - 6)	1		2F	Each bit =1 dB of gain reduction		0 = no activity and 47 for AGC
Reserved	3					

Payload length: 51 bytes

1. Field not filled for GSW3 and GSWLT3 software in Test Mode 3/4.
2. Phase error = (Q20ms)/(I20ms).
3. Only for GSWLT3 and SLCLT3 software

Table 3-78 Detailed Description of Test Mode 3/4 Message ID 46

Name	Description
Message ID	Message ID number.
SV ID	The number of the satellite being tracked.
Period	The total duration of time (in seconds) that the satellite is tracked. This field is not filled for GSW3 and GSWLT3 software in Test Mode 3/4.
Bit Sync Time	The time it takes for channel 0 to achieve the status of 0x37. This field is not filled for GSW3 and GSWLT3 software in Test Mode 3/4.
Bit Count	The total number of data bits that the receiver is able to demodulate during the test period. As an example, for a 20 second test period, the total number of bits that can be demodulated by the receiver is 12000 (50 bps x 20 sec x 12 channels). This field is not filled for GSW3 and GSWLT3 software in Test Mode 3/4.
Poor Status	This value is derived from phase accumulation time. Phase accumulation is the amount of time a receiver maintains phase lock. Every 100 msec of loss of phase lock equates to 1 poor status count. As an example, the total number of status counts for a 60 second period is 7200 (12 channels x 60 sec x 10 100-ms intervals). This field is not filled for GSW3 and GSWLT3 software in Test Mode 3/4.
Good Status	This value is derived from phase accumulation time. Phase accumulation is the amount of time a receiver maintains phase lock. Every 100 msec of phase lock equates to 1 good status count. This field is not filled for GSW3 and GSWLT3 software in Test Mode 3/4.
Parity Error Count	The number of word parity errors. This occurs when the transmitted parity word does not match the receivers parity check. This field is not filled for GSW3 and GSWLT3 software in Test Mode 3/4.
Lost VCO Count	The number of 1 msec VCO lost lock was detected. This occurs when the PLL in the RFIC loses lock. A significant jump in crystal frequency and / or phase will cause a VCO lost lock. This field is not filled for GSW3 and GSWLT3 software in Test Mode 3/4.
Frame Sync	The time it takes for channel 0 to reach a 0x3F status. This field is not filled for GSW3 and GSWLT3 software in Test Mode 3/4.
C/No Mean	Calculated average of reported C/No by all 12 channels during the test period.
C/No Sigma	Calculated sigma of reported C/No by all 12 channels during the test period.
Δ Clock Drift	Difference in clock drift from start and end of the test period.
Clock Drift	The measured internal clock drift.
Bad 1Khz Bit Count	Errors in 1 ms post correlation I count values. This field is not filled for GSW3 and GSWLT3 software in Test Mode 3/4.

Table 3-78 Detailed Description of Test Mode 3/4 Message ID 46 *(Continued)*

Name	Description
Abs I20ms	Absolute value of the 20 ms coherent sums of the I count over the duration of the test period.
Abs Q1ms	Absolute value of the 1 ms Q count over the duration of the test period.
Phase Lock Indicator	Quality of the phase lock loop.
RTC Frequency[1]	F(RTC counts/CLCKACQ counts over test interval). 16-bit unsigned integer value of RTC frequency in Hz. Value = 0, no RTC Value = 1 to 65534, 32678+/-1 = good RTC frequency Value = 65535, RTC frequency = 65535 Hz of higher
ECLK Ratio[1]	F(ECLK counts/CLCKACQ counts over test interval. 16-bit unsigned integer value of scaled value of ration. Value = 0, no ECLK input 0< Value <3, Ratio = 3*Value/65535 Value >3, Ration = 65535
Timer Synch[1]	Timer Synch activity bit. Value = 0, no Timer Synch activity Value = 1, activity
AGC[1]	Automatic Gain Control value. Value = 0, gain set to maximum saturated 0< Value > 62, active gain range Value = 63, gain set to minimum saturated

1. Supported only by GSWLT3 and SLCLT3 software. When test mode command is issued, test report interval time value and PRN are specified. Reports every interval whether SV signals or not and data is accumulated every interval period. Continuous output until software is reset or unit is restarted.

Test Mode 4 - Message ID 48 (SiRFLoc v2.x only)

SiRFLoc results from Test Mode 4 are output by message IDs 48 and 49. Message ID 48 for Test Mode 4 used by SiRFLoc version 2.x only is not to be confused with SiRFDRive message ID 48.

Table 3-79 Test Mode 4 - Message ID 48

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		30			48
nChannel	1		01			1
Reserved	4		00000000			0
Channel	1		00			0
Satellite ID	1		18			24
Receiver Time Tag	4		000660D0	ms		30995
Pseudo-range	4	A	0	m	10	0
Carrier Frequency	4	64	174ADC	m/sec	100	1526492

Payload length: 20 bytes

Table 3-80 Detailed Description of Test Mode 4 Message ID 48

Name	Description
Message ID	Message ID number.
nChannel	Number of channels reporting.
Reserved	Reserved.

Table 3-80 Detailed Description of Test Mode 4 Message ID 48 *(Continued)*

Name	Description
Channel	Receiver channel number for a given satellite being searched or tracked
Satellite ID	Satellite or Space Vehicle (SV ID number or Pseudo-Random Noise (PRN) number.
Receiver Time Tag	Count of ms interrupts from the start of the receiver (power on) until measurement sample is taken. Millisecond interrupts are generated by the receiver clock.
Pseudorange	Generated pseudorange measurement for a particular SV.
Carrier Frequency	Can be interpreted in two ways: 1. Delta pseudorange normalized by the reciprocal of the delta pseudorange measurement interval. 2. Frequency from the AFC loop. If, for example, the delta pseudorange interval computation for a particular channel is zero, it can be the AFC measurement, otherwise it is a delta pseudorange computation.

DR Navigation Status - Message ID 48 (Sub ID 1)

DR navigation status information (output on every navigation cycle).

Table 3-81 DR Navigation Status

Name	Bytes	Description
MID	1	=0x30
Sub ID	1	=0x01
DR navigation	1	0x00 = valid DR navigation; else Bit 0 ON : GPS-only navigation required Bit 1 ON : speed not zero at start-up Bit 2 ON : invalid DR position Bit 3 ON : invalid DR heading Bit 4 ON : invalid DR calibration Bit 5 ON : invalid DR data Bit 6 ON : system in Cold Start Bit 7 : Reserved
DR data	2	0x0000 = valid DR data; else Bit 0 ON : DR gyro subsystem not operational Bit 1 ON : DR speed subsystem not operational Bit 2 ON : DR measurement time < 80 ms Bit 3 ON : invalid serial DR message checksum Bit 4 ON : no DR data for > 2 sec Bit 5 ON : DR data timestamp did not advance Bit 6 ON : DR data byte stream all 0x00 or 0xFF Bit 7 ON : composite wheel-tick count jumped > 255 between successive DR messages Bit 8 ON : input gyro data bits (15) of 0x0000 or 0x3FFF Bit 9 ON : > 10 DR messages received in 1 sec Bit 10 ON : time difference between two consecutive measurements is <= 0 Bits 11 - 15 : Reserved.

Table 3-81 DR Navigation Status *(Continued)*

Name	Bytes	Description
DR calibration and DR gyro bias calibration	1	Bits 0 - 3 : 0000 = valid DR calibration; else Bit 0 ON : invalid DR gyro bias calibration Bit 1 ON : invalid DR scale factor calibration Bit 2 ON : invalid DR speed scale factor calibration Bit 3 ON : GPS calibration required but not ready Bits 4 - 6 : 000 = valid DR gyro bias calibration; else Bit 4 ON : invalid DR data Bit 5 ON : zero-speed gyro bias calibration not updated Bit 6 ON : heading rate scale factor <= -1 Bit 7 : Reserved
DR gyro scale factor calibration and DR speed scale factor calibration	1	Bits 0 - 3 : 0000 = valid DR gyro scale factor calibration; else Bit 0 ON : invalid DR heading Bit 1 ON : invalid DR data Bit 2 ON : invalid DR position Bit 3 ON : heading rate scale factor <= -1 Bits 4 - 7 : 0000 = valid DR speed scale factor calibration; else Bit 4 ON : invalid DR data Bit 5 ON : invalid DR position Bit 6 ON : invalid GPS velocity for DR Bit 7 ON : DR speed scale factor <= -1
DR Nav across reset and DR position	1	Bits 0 - 1 : 00 = valid DR nav across reset; else Bit 0 ON : invalid DR navigation Bit 1 ON : speed > 0.01 m/s Bit 2 : Reserved Bits 3 - 6 : 0000 = valid DR position; else Bit 3 ON : speed not zero at start-up Bit 4 ON : invalid GPS position Bit 5 ON : system in Cold Start Bit 6 ON : invalid DR data Bit 7 : Reserved
DR heading	1	Bits 0 - 6 : 0000000 = valid DR heading; else Bit 0 ON : speed not zero at start-up Bit 1 ON : invalid GPS position Bit 2 ON : invalid GPS speed Bit 3 ON : GPS did not update heading Bit 4 ON : delta GPS time < 0 and > 2 Bit 5 ON : system in Cold Start Bit 6 ON : invalid DR data Bit 7 : Reserved
DR gyro subsystem and DR speed subsystem	1	Bits 0 - 3 : 0000 = updated DR gyro bias and scale factor calibration; else Bit 0 ON : invalid DR data Bit 1 ON : invalid DR position Bit 2 ON : invalid GPS velocity for DR Bit 3 ON : GPS did not update heading Bits 4 - 6 : 000 = updated DR speed calibration; else Bit 4 ON : invalid DR data Bit 5 ON : invalid DR position Bit 6 ON : invalid GPS velocity for DR Bit 7 : 0 = updated DR navigation state

Table 3-81 DR Navigation Status *(Continued)*

Name	Bytes	Description
DR Nav state integration ran and zero-speed gyro bias calibration updated	1	Bits 0 - 7 : 00000000 = GPS updated position; else Bit 0 ON : update mode != KF Bit 1 ON : EHPE > 50 Bit 2 ON : no previous GPS KF update Bit 3 ON : GPS EHPE < DR EHPE Bit 4 ON : DR EHPE < 50 Bit 5 ON : less than 4 SVs in GPS navigation Bit 6 ON : no SVs in GPS navigation Bit 7 ON : DR-only navigation required
Updated DR gyro bias/scale factor calibration, updated DR speed calibration, and updated DR Nav state	1	Bits 0 - 3 : 0000 = updated DR gyro bias and scale factor calibration; else Bit 0 ON : invalid DR data Bit 1 ON : invalid DR position Bit 2 ON : invalid GPS velocity for DR Bit 3 ON : GPS did not update heading Bits 4 - 6 : 000 = updated DR speed calibration; else Bit 4 ON : invalid DR data Bit 5 ON : invalid DR position Bit 6 ON : invalid GPS velocity for DR Bit 7 : 0 = updated DR navigation state
GPS updated position	1	Bits 0 - 7 : 00000000 = GPS updated position; else Bit 0 ON : update mode != KF Bit 1 ON : EHPE > 50 Bit 2 ON : no previous GPS KF update Bit 3 ON : GPS EHPE < DR EHPE Bit 4 ON : DR EHPE < 50 Bit 5 ON : less than four SVs in GPS navigation Bit 6 ON : no SVs in GPS navigation Bit 7 ON : DR-only navigation required
GPS updated heading	1	Bits 0 - 6 : 0000000 = GPS updated heading; else Bit 0 ON : update mode != KF Bit 1 ON : GPS speed <= 5 m/s Bit 2 ON : less than 4 SVs in GPS navigation Bit 3 ON : horizontal velocity variance > 1 m^2/s^2 Bit 4 ON : GPS heading error >= DR heading error Bit 5 ON : GPS KF not updated Bit 6 ON : incomplete initial speed transient Bit 7 : Reserved
GPS position & GPS velocity	1	Bits 0 - 2 : 000 = valid GPS position for DR; else Bit 0 ON : less than 4 SVs in GPS navigation Bit 1 ON : EHPE > 30 Bit 2 ON : GPS KF not updated Bit 3 : Reserved Bits 4 - 7 : 0000 = valid GPS velocity for DR; else Bit 4 ON : invalid GPS position for DR Bit 5 ON : EHVE > 3 Bit 6 ON : GPS speed < 2 m/s Bit 7 ON : GPS did not update heading.
Reserved	2	Reserved

Payload length: 17 bytes

DR Navigation State - Message ID 48 (Sub ID 2)

DR speed, gyro bias, navigation mode, direction, and heading (output on every navigation cycle).

Table 3-82 DR Navigation State

Name	Bytes	Scale	Units	Description
MID	1			=0x30
Sub ID	1			=0x02
DR speed	2	10^2	m/s	
DR speed error	2	10^4	m/s	
DR speed scale factor	2	10^4		
DR speed scale factor error	2	10^4		
DR heading rate	2	10^2	deg/s	
DR heading rate error	2	10^2	deg/s	
DR gyro bias	2	10^2	deg/s	
DR gyro bias error	2	10^2	deg/s	
DR gyro scale factor	2	10^4		
DR gyro scale factor error	2	10^4		
Total DR position error	4	10^2	m	
Total DR heading error	2	10^2	deg	
DR Nav mode control	1			1=GPS-only nav required (no DR nav allowed) 2=GPS + DR nav using default/stored calibration 3=GPS + DR nav using current GPS calibration 4=DR-only nav (no GPS nav allowed)
Reverse	1			DR direction: 0 = forward; 1 = reverse.
DR heading	2	10^2	deg/s	

Payload length: 32 bytes

Navigation Subsystem - Message ID 48 (Sub ID 3)

Heading, heading rate, speed, and position of both GPS and DR (output on every navigation cycle).

Table 3-83 Navigation Subsystem

Name	Bytes	Scale	Units	Description
MID	1			=0x30
Sub ID	1			=0x03
GPS heading rate	2	10^2	deg/s	
GPS heading rate error	2	10^2	deg/s	
GPS heading	2	10^2	deg	
GPS heading error	2	10^2	deg	
GPS speed	2	10^2	m/s	
GPS speed error	2	10^2	m/s	
GPS position error	4	10^2	m	
DR heading rate	2	10^2	deg/s	

Table 3-83 Navigation Subsystem *(Continued)*

Name	Bytes	Scale	Units	Description
DR heading rate error	2	10^2	deg/s	
DR heading	2	10^2	deg	
DR heading error	2	10^2	deg	
DR speed	2	10^2	m/s	
DR speed error	2	10^2	m/s	
DR position error	4	10^2	m	
Reserved	2			

Payload length: 36 bytes

DR Gyro Factory Calibration - Message ID 48 (Sub ID 6)

DR gyro factory calibration parameters (response to poll).

Table 3-84 DR Gyro Factory Calibration

Name	Bytes	Scale	Units	Description
MID	1			=0x30
Sub ID	1			=0x06
Calibration	1			Bit 0 : Start gyro bias calibration. Bit 1 : Start gyro scale factor calibration. Bits 2 - 7 : Reserved.
Reserved	1			

Payload length: 4 bytes

DR Sensors Parameters - Message ID 48 (Sub ID 7)

DR sensors parameters (response to poll).

Table 3-85 DR Sensors Parameters

Name	Bytes	Scale	Units	Description
MID	1			=0x30
Sub ID	1			=0x07
Base speed scale factor	1		ticks/m	
Base gyro bias	2	10^4	mV	
Base gyro scale factor	2	10^3	mV/deg/s	

Payload length: 7 bytes

DR Data Block - Message ID 48 (Sub ID 8)

1-Hz DR data block (output on every navigation cycle).

Table 3-86 DR Data Block

Name	Bytes	Scale	Units	Description
MID	1			=0x30
Sub ID	1			=0x08
Measurement type	1			0 = odometer and gyroscope (always); 1 .. 255 = Reserved.
Valid count	1			Count (1 .. 10) of valid DR measurements.
Reverse indicator	1			Bits 0 .. 9, each bit: ON = reverse, OFF = forward.
1st 100-ms time-tag	1		ms	
1st 100-ms DR speed	1	10^2	m/s	
1st 100-ms gyro heading rate	1	10^2	deg/s	
2^{nd} 100-ms time-tag	1		ms	
2^{nd} 100-ms DR speed	1	10^2	m/s	
2^{nd} 100-ms gyro heading rate	1	10^2	deg/s	
...				
10^{th} 100-ms time-tag	1		ms	
10^{th} 100-ms DR speed	1	10^2	m/s	
10^{th} 100-ms gyro heading rate	1	10^2	deg/s	

Payload length: 86 bytes

Test Mode 4 - Message ID 49

SiRFLoc results from Test Mode 4 are output by message IDs 48 and 49. Message ID 48 for Test Mode 4 used by SiRFLoc version 2.x only is not to be confused with SiRFDRive message ID 48.

Table 3-87 Test Mode 4 - Message ID 49

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		31			49
nChannel	1		01			1
Reserved	4		00000000			0
Channel	1		00			0
Satellite ID	1		18			24
Receiver Time Tag	4		000660D0	ms		31085
Carrier Doppler Rate	4	100000	796D	carrier cycles/2ms/10ms	1048576	271
Carrier Doppler	4	100000	10F	carrier cycles/2ms	1048576	168229578
Carrier Phase	4	400		carrier cycles	1024	94319770
Code Offset	4	181000	FFFFFFFFF FFC925C	chip	1576960	-224676

Payload length: 28 bytes

Table 3-88 Detailed Description of Test Mode 4 Message ID 49

Name	Description
Message ID	Message ID number.
nChannel	Number of channels reporting.
Channel	Receiver channel number for a given satellite being searched or tracked
Satellite ID	Satellite or Space Vehicle (SV ID number or Pseudo-Random Noise (PRN) number.
Receiver Time Tag	Count of ms interrupts from the start of the receiver (power on) until measurement sample is taken. Millisecond interrupts are generated by the receiver clock.
Carrier Doppler Rate	Carrier Doppler Rate value from the Costas tracking loop for the satellite ID on channel 0.
Carrier Doppler	Frequency from the Costas tracking loop for the satellite ID on channel 0.
Carrier Phase	Carrier phase value from the Costas tracking loop for the satellite ID on channel 0.
Code Offset	Code offset from the Code tracking loop for the satellite ID on channel 0.

SBAS Parameters - Message ID 50

Outputs SBAS operating parameter information including SBAS PRN, mode, timeout, timeout source, and SBAS health status.

Output Rate: Every measurement cycle (full power / continuous: 1Hz)

Example:

A0A2000D—Start Sequence and Payload Length

327A00120000000000000000000—Payload

BEBEB0B3—Message Checksum and End Sequence

Table 3-89 SBAS Parameters - Message ID 50

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		32			50
SBAS PRN	1		7A			122
SBAS Mode	1		00			0
DGPS Timeout	1		12			18
Flag bits	1		00			0
Spare	8		0000000000000000			00000000

Payload length: 13 bytes

Table 3-90 Detailed Description of SBAS Parameters

Name	Description
Message ID	Message ID number.
SBAS PRN	0=Auto mode SBAS PRN 120-138= Exclusive
SBAS Mode	0=Testing, 1=Integrity Integrity mode will not accept SBAS corrections if the SBAS satellite is transmitting in a test mode. Testing mode will accept and use SBAS corrections even if the SBAS satellite is transmitting in a test mode.
DGPS Timeout	Range 1-250 seconds. 0 returns to default timeout. The last received corrections will continue to be applied to the navigation solution for the timeout period. If the timeout period is exceeded before a new correction is received, no corrections will be applied.
Flag bits	Bit 0: Timeout; 0=Default 1=User Bit 1: Health; Reserved Bit 2: Correction; Reserved Bit 3: SBAS PRN; 0=Default 1=User
Spare	Spare

1 PPS Time - Message ID 52

Output time associated with current 1 PPS pulse. Each message is output within a few hundred ms after the 1 PPS pulse is output and tells the time of the pulse that just occurred. The MID 52 reports the UTC time of the 1 PPS pulse when it has a current status message from the satellites. If it does not have a valid status message, it reports time in GPS time, and so indicates by means of the status field.

Output Rate: 1 Hz (Synchronized to PPS)

Example:

A0A20013—Start Sequence and Payload Length

3415122A0E0A07D3000D00000050700000000—Payload

0190B0B3—Message Checksum and End Sequence

Table 3-91 Timing Message Data - Message ID 52

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		34			52
Hour	1		15			21
Minute	1		12			18
Second	1		2A			42
Day	1		0E			15
Month	1		0A			10
Year	2		07D3			2003
UTCOffsetInt[1]	2		000D			13

Table 3-91 Timing Message Data - Message ID 52 *(Continued)*

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
UTCOffsetFrac[1]	4	10^9	00000005	sec	10^9	0.000000005
Status (see Table 3-92)	1		7			7
Reserved	4		00000000			00000000

Payload length: 19 bytes

1. Difference between UTC and GPS time, integer, and fractional parts. GPS time = UTC time + UTCOffsetInt+UTCOffsetFrac x 10^{-9}.

Table 3-92 Status Byte Field in Timing Message

Bit Fields	Meaning
0	When set, bit indicates that time is valid.
1	When set, bit indicates that UTC time is reported in this message. Otherwise it is GPS time.
2	When set, bit indicates that UTC to GPS time information is current, (i.e., IONO/UTC time is less than 2 weeks old).
3-7	Reserved

Test Mode 4 Track Data - Message ID 55

Message ID 55 is used by GSW3, GSWLT3, and SiRFLoc (v3.0 and above) software.

Table 3-93 Test Mode 4 - Message ID 55

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		37			55
SV ID	2		0001			1
Acqclk Lsq	4		12345678			12345678
Code Phase	4	2^{-11}	0000	Chips		0
Carrier Phase	4	2^{-32}	0000	Cycles		0
Carrier Frequency	4	0.000476	0000	Hz	0.000476	0
Carrier Acceleration	2	0.476	0000	Hz/sec	0.476	0
Code Corrections	4		0000			0
Code Offset	4	2^{-11}	0000	Chips	2^{-11}	0
MSec Number[1]	2	ms	0006	ms	0.001	0.006
Bit Number[1]	4	20 ms	01C6	20 ms	0.02	9.08
Reserved	4		0000			
Reserved	4		0000			
Reserved	4		0000			
Reserved	4		0000			

Payload length: 51 bytes

1. SiRFLocDemo combines MSec Number and Bit Number for this message output which gives the GPS time stamp.

Extended Ephemeris Data - Message ID 56

Message ID 56 is used by GSW2 (2.5 or above), SiRFXTrac (2.3 or above), and GSW3 (3.2.0 or above), and GSWLT3 software. This message has three Sub IDs.

Table 3-94 Extended Ephemeris - Message ID 56

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		38			56
Message Sub ID	1		01			1

Payload length: variable (2 bytes + Sub ID payload bytes)

GPS Data and Ephemeris Mask - Message ID 56 (Sub ID 1)

Output Rate: 6 seconds until extended ephemeris is received

Example:

A0A2000D—Start Sequence and Payload Length

380101091E00000E7402000001 – Payload (message ID, sub ID, time valid; GPS week = 2334; GPS TOW = 37000 seconds; request flag for satellite 30 and 1)

00E6B0B3—Message Checksum and End Sequence

Table 3-95 GPS Data and Ephemeris Mask - Message ID 56 (Sub ID 1)

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		38			56
Message Sub ID	1		01			1
GPS_TIME_VALID_FLAG	1		01			1
GPS Week	2	1	091E			2334
GPS TOW	4	10	00000E74	seconds		3700
EPH_REQ_MASK	4		02000001			SVs 30 and 1

Payload length: 13 bytes

Table 3-96 Detailed Description of GPS Data and Ephemeris Mask Parameters

Name	Description
Message ID	Message ID number.
Message Sub ID	Message Sub ID number.
GPS_TIME_VALID_FLAG	LSB bit 0 = 1, GPS week is valid. LSB bit 0 = 0, GPS week is not valid. LSB bit 1 = 1, GPS TOW is valid. LSB bit 1 = 0, GPS TOW is not valid.

Table 3-96 Detailed Description of GPS Data and Ephemeris Mask Parameters *(Continued)*

Name	Description
GPS Week	Extended week number. Range from 0 to no limit
GPS TOW	GPS Time Of Week. Multiply by 10 to get the time in seconds. Range 0 to 604800 seconds.
EPH_REQ_MASK	Mask to indicate the satellites for which new ephemeris is needed. MSB is used for satellite 32, and LSB is for satellite 1.

Extended Ephemeris Integrity - Message ID 56 (Sub ID 2)

Output Rate: Upon GPS receiver's request

Example:

A0A2000E—Start Sequence and Payload Length

380200000040000000040000000040 – Payload (message ID, Sub ID, invalid position and clocks for SVID 7, and unhealthy bit for SVID 7)

00FAB0B3—Message Checksum and End Sequence

Table 3-97 Extended Ephemeris Integrity Parameters - Message 56 (Sub ID 2)

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		38			56
Message Sub ID	1		02			2
SAT_POS_VALIDITY_FLAG	4		00000040			flag = 1, SV = 7
SAT_CLK_VALIDITY_FLAG	4		00000040			flag = 1, SV = 7
SAT_HEALTH_FLAG	4		00000040			flag = 1, SV = 7

Payload length: 14 bytes

Table 3-98 Detailed Description of Extended Ephemeris Integrity Parameters

Name	Description
Message ID	Message ID number.
Message Sub ID	Message Sub ID number.
SAT_POS_VALIDITY_FLAG	1 = invalid position found, 0 = valid position. SVID 1 validity flag is in LSB and subsequent bits will have validity flags for SVIDs in increasing order up to SVID 32 whose validity flag will be in MSB.
SAT_CLK_VALIDITY_FLAG	1 = invalid clock found, 0 = valid clock. SVID 1 validity flag is in LSB and subsequent bits will have validity flags for SVIDs in increasing order up to SVID 32 whose validity flag will be in MSB.
SAT_HEALTH_FLAG	1 = unhealthy satellite, 0 = healthy satellite. SVID 1 health flag is in the LSB and subsequent bits will have health flags for SVIDs in increasing order up to SVID 32 whose validity flag will be in MSB.

Extended Ephemeris ACK - Message ID 56 (Sub ID 255)

Output Rate: Variable.

This message is returned when input Message ID 232 sub ID 255 is received. Refer to Chapter 2, “Input Messages” for more details on Message ID 232.

Example:

A0A20004—Start Sequence and Payload Length

E8FFE8FF – Payload (ACK for message 232 sub ID 255)

03CEB0B3—Message Checksum and End Sequence

Table 3-99 Extended Ephemeris Ack - Message 56 (Sub ID 255)

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		E8			232
Message Sub ID	1		FF			255
ACK ID	1		E8			232
ACK Sub ID	1		FF			255

Payload length: 4 bytes

*Table 3-100*Detailed Description of Extended Ephemeris Ack Parameters

Name	Description
Message ID	Message ID number.
Message Sub ID	Message Sub ID number.
ACK ID	Message ID of the message to ACK.
ACK Sub ID	Message Sub ID of the message to ACK.

Reserved - Message ID 225

This output message is SiRF proprietary except for sub ID 6.

Statistic Channel - Message ID 225 (Sub ID 6)

The message is only used by GSW3, GSWLT3, and SiRFLoc v3.x software and outputs the TTFF, aiding accuracy information and navigation status.

Output Rate: Once after every reset.

Note – Message ID 225 (sub ID 6) only comes out when the debug messages are enabled. The debug message feature is enabled by either setting the output rate of message 225 using MID 166 or by setting bit 5 (enable debug data bit) in the configuration bit map of MID 128.

Note – Message ID 225 (sub ID 6) may not be output when the system is not able to compute a navigation solution. This message is not supported by APM.

Example:

A0A20027—Start Sequence and Payload Length

E106—Message ID and Sub ID

01000000000000000000000000000000000000000000000000000000000000000101000000
0—Payload

0107B0B3—Message Checksum and End Sequence

Table 3-101 Statistic Channel - Message ID 225

Name	Sub Field	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
			Scale	Example		Scale	Example
Message ID		1		E1			225
Message Sub ID		1		06			6
TTFF	Since reset	2			second	0.1	range from 0 .0 to 6553.5
	Since all aiding received[1]	2					0
	First nav since reset[1]	2					0
Position Aiding Error	North[1]	4					0
	East[1]	4					0
	Down[1]	4					0
Time Aiding Error[1]		4					0
Frequency Aiding Error[1]		2					0
Position Uncertainty	Horizontal[1]	1					0
	Vertical[1]	2					0
Time Uncertainty[1]		1					0
Frequency Uncertainty[1]		1					0
Number of Aided Ephemeris[1]		1					0
Number of Aided Acquisition Assistance[1]		1					0
Navigation and Position Status	Navigation Mode	1					see Table 3-102
	Position Mode	1					see Table 3-103
	Status	2					see Table 3-104 and Table 3-105
Start Mode		1					see Table 3-106
Reserved[1]		1					

Payload length: 39 bytes

1. Valid with SiRFLoc only.

*Table 3-102*Description of the Navigation Mode Parameters

Bit Fields	Description
0	No Nav
1	Approximate from SV records
2	Time transfer
3	Stationary mode
4	LSQ fix
5	KF nav
6	SiRFDRive
7	DGPS base

*Table 3-103*Description of the Position Mode Parameters

Bit Fields	Description
0	Least Square (LSQ) mode 0 - no bit sync, approximate GPS time
1	LSQ mode 1 - no bit sync, accurate GPS time
2	LSQ mode 2 - bit sync, no frame sync, approximate GPS time
3	LSQ mode 3 - bit sync, no frame sync, accurate GPS time
4	LSQ mode 4 - bit and frame sync, user time (without aiding) - see also Table 3-104
5	KF mode - Kalman Filtering
6	No position
7	Not used

*Table 3-104*Description of the Status for Navigation LSQ Fix Mode

Value	Status
0x00	Good solution
0x01	Uncertainty exceeded maximum (UNCER_EXCEED)
0x02	Input information to navigation had error (INPUT_ERR)
0x04	Not sufficient information to have a fix position (UNDER_DETERM)
0x08	Matrix inversion failed (MATR_INVT)
0x010	LSQ iteration exceeds predefined maximum (ITER_OUT)
0x020	Altitude check failed (ALT_OUT)
0x040	GPS time check failed (TIME_OFF)
0x080	Failure found in measurements (FDI_FAIL)
0x100	DOP exceeded threshold (DOP_FAIL)
0x200	Velocity check failed (VEL_FAIL)

*Table 3-105*Description of the Status for Navigation KF Mode

Value	Status
0	Solution is good
1	No solution
2	Altitude is out of range
3	Velocity is out of range

*Table 3-106*Description of the Start Mode

Value	Description
0x00	Cold
0x01	Warm
0x02	Hot
0x03	Fast

Development Data - Message ID 255

Output Rate: Receiver generated.

Example:

A0A2....—Start Sequence and Payload Length

FF....—Payload

....B0B3—Message Checksum and End Sequence

*Table 3-107*Development Data - Message ID 255

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		FF			255
Data[1]	variable					

Payload length: variable

1. Data area consists of at least 1 byte of ASCII text information.

Note – MID 255 is output when SiRF Binary is selected and development data is enabled. It can also be enabled by setting its output rate to 1 using message ID 166. The data output using MID 255 is essential for SiRF-assisted troubleshooting support.

Additional Information 4

TricklePower Operation in DGPS Mode

When in TricklePower mode, serial port DGPS corrections are supported. The CPU goes into sleep mode but will wake up in response to any interrupt. This includes UARTs. Messages received during the TricklePower ‘off’ period are buffered and processed when the receiver awakens for the next TricklePower cycle.

GPS Week Reporting

The GPS week number represents the number of weeks that have elapsed since the week of January 6, 1980. Per ICD-GPS-200, the satellites only transmit the 10 LSBs of the week number. On August 22, 1999, the week number became 1024, which was reported by the satellites as week 0. SiRF receivers resolve the reported week number internally. When messages report the week number, that value will either be truncated to the 10 LSBs or will be called an extended week number (see messages 7 and 41 for examples).

ADDITIONAL PRODUCT INFORMATION

Part Number	Description
1050-0042	NMEA Reference Manual
1050-0041	SiRF Binary Protocol Reference Manual

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SiRF Binary Protocol Reference Manual
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